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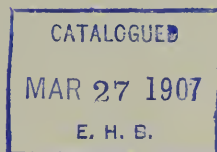
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DISEASES OF THE HEAD AND BRAIN — Figure A

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NUMBER ONE

A CONTRIBUTION TO THE RADIODIAGNOSIS OF DISEASES OF THE HEAD AND BRAIN*

BY PROFESSOR, DR. MAURICE BENEDIKT, OF VIENNA, AUSTRIA

IN harmony with rules of optics, we are obliged to suppose that any difference of penetrability or impenetrability of any substance in the path of X-rays should appear on the sensitive film used in photographing by means of such rays.

Every "shadow" must be intensified when a substance of little penetrability is in the path, and the shadow must become clearer if the light passes through a substance of the contrary quality. Every clear spot on the diagram must become darker, however, when in the line of the light there is a substance of less penetrability, and the spot must become clearer when a substance of greater penetrability is in the way. Experience appears to be opposed to this theoretical supposition, but in fact there exist merely different secondary conditions which seem to controvert the theory.

When we observe the human chest, it seems that almost all of the organs in the path of the light appear on the plate and produce a picture showing their positions.

As to the diagrams of the head, the general opinion exists that they show with rare exceptions only the morphological relations of the skull. This generally accepted view is fundamentally controverted by the fact that on excellent diagrams can be recognized all the air-cavities of the skull, not only of the greater ones, such as the frontal, but also those of the ethmoid and sphenoid bones.

The optical effect upon the plate of the air included in massive bones and of that which separates two bones proves that the general opinion referred to is erroneous. This opinion seems the more erroneous since the cavities of the labyrinth also appear on the plate.

We can understand the appearance of the air-cavities by the consideration that the Roentgen light is much diffused by passage through air. Therefore,

*Read before the *Electro-Therapeutical section of the International Electrical Congress held at St. Louis, Mo., September 12-17, 1904.*

parts containing air have the quality of brilliancy and in this way produce a strong effect on the plate.

When the mass of air is great, as in the chest-cavity or in the bowels, then this brilliancy has a clouding effect on the surrounding parts and blurs the diagram. Therefore, in the chest-picture the gristle of the bronchi is not seen and a distinct picture is not obtained of the aorta. For this reason also the diagram of the abdominal organs is blurred.

Fatty matter has this characteristic of brilliancy and, therefore, also blurs the picture in a high degree.

In two cases of extreme emaciation with distaste for food, the bowels being empty of air and there being no deposit of fat, I could see distinctly the abdominal organs and the kidneys, even with the screen alone. We must consider another quality of the Roentgen light, namely, that it is a whirling light produced by interruption of the electric current. For this reason lateral undulations enter in the direct rays and produce in the picture effects of lateral light. Therefore, the pictures become irregularly blurred. To prevent this effect, we must use diaphragms, the best being in the form of lead plates with relatively narrow holes.

There exist certain substances which seem little disposed to permit the entrance of lateral undulations and which conduct concentrated beams of Roentgen light, such as the brain.

When we examine a perfect profile diagram of the head we see the circumference of the skull from the upper nasal point to near the posterior point of the foramen occipitale magnum. We see also many details of the osseous base of the skull. The space between the osseous circumference and the osseous base is filled up in the negative by a grey, cloudy shadow which represents optically the mass of the brain influenced by the lateral walls of the skull.

Every alteration of these walls, of the surface of the brain and of its interior may appear in the diagram either as a shadow or as a clear spot. By a close study of the case we may decide if the osseous integuments, or the brain and its membranous integuments, or its interior are altered.

We may, indeed must, choose cases in which the pathological process and the localization are as clear as possible. This happens especially in simple traumatic cases in which the shock has no influence. I have communicated lately four such cases,¹ and in the present paper I wish to call attention to two others of such traumatic cases. In these the pathological process may be either simple bleeding or pachymeningitis, principally hæmorrhagica, if severe lesions of osseous parts are excluded. Another important morbid condition in such cases is the presence of abscesses. I believe that such a focus is more penetrable than the substance of the brain, because in the paper referred to as well as in the present one, the observed focuses were "shadows." I believe this excludes the presence of abscesses in such cases.² A third case belongs to those cases of epilepsy which are the effect of osseous stratification during pregnancy.

The focus of the lateral parts of the brain and of its interior give pictures so delicate that a reproduction by photography is impossible and we are obliged to resort to drawing. The figures in this paper are drawn from the sensitive side of the plate.

The impenetrable parts, which in reality appear clear on the negative, I shall call "shadows." The diagrams

¹ *Zeitschr. für Elektrotherapie*; von Kurella, Leipzig, 1904.

² A traumatic case, in which the focus was more penetrable. "Zur Roetgendiagnostik der traumat. Neurose." *Wiener Medic. Presse*, 1903, No. 26.

were made by Dr. Kienboeck. The special method is described in the paper already cited.

Before I pass to the discussion of the cases I will explain the radiograph of the base of the skull. It represents a severe case of ozoena, in which a congenital lack of the sphenoidal cavity exists. Fig. A is a photographic reproduction of a plate from the sensitive side by the use of a diapositive. The greatest difficulty in understanding the radiograph pictures of the base of the head arises from the appearance of the pyramid of the other side in the picture. Though we have taken the greatest care in placing the medial plane of the head parallel to the plane of the photographic plate, this occurs for two reasons. The first is the natural asymmetry of the halves of the skull; the second is that the person photographed involuntarily turned his head so that the pyramid of the opposite side appears higher and behind the pyramid nearer to the plate. Rising from the frontal cavity are seen two shadows, which correspond to the highest edges of the roof of the orbital cavity *ob*. The base then continues to the sphenoid bone and we can recognize the outlines of the tuberculum *tb* and of the sella turcia *st* of the bone in question with the clivus *cl* behind. Sometimes we can perceive the ends of the alae minores *al*. Below the highest point of the pyramid, which I will call colliculus pyramidis *co*, we see some cavities, which can only be the cavities of the labyrinth *lb*, the canales semi-circulares, and in front of them the cochlea or the vestibulum. We can also perceive one or two cavities, which are representatives of the meatus auditorius, *au*, internus or externus. But as the second pyramid appears also we may see below the corresponding point *co'* traces of the cavities of the labyrinth of the other side.

The aspect of the second pyramid is shortened, so that the posterior part of

it is not visible, and thus the picture of this pyramid may end in a sharp point.

Below the outline of the sphenoid bone we see the sphenoidal cavities *k*, and in front of them the ethmoidal cavities *si*. Below are seen strongly marked the outlines of the upper part of the maxilla inferior and the teeth of the maxilla superior. I marked these outlines by means of a colored pencil on the glass-side of the original plate for better identification.

I will now pass to the description of the cases:

Case 1. — Kolar, M., engine-driver. On June 6, 1897, while leaning out of the engine, he struck his head against a lateral object. He lost consciousness, vomited and was confined to his bed for six days. He tried to resume work, but could not continue. On October 16 of the same year he came for the first time under my observation. He complained of violent headache, and his face had the rigid expression of a mask. Standing erect with his eyes closed he showed signs of static vertigo. Other symptoms were: adynamia of the right arm with tremor when attempting to overcome any resistance. When moving either arm, he involuntarily moved the left leg. The tongue deviated in a slight degree to the right side. When his head was turned in the sense of the vertical axis, he felt a pain in the region of the atlas.

His hearing was defective on the right side and there was a cicatrix on his tympanic membrane. The whole head was very sensitive to percussion. The ophthalmological examination with the mirror and with the perimeter gave a negative result.

At first this case did not seem very serious, but I was not able to relieve him of his violent headaches. I applied iodine, franklinisation of the head, ice-bags, and "points de feu" without result. The trouble increased, and after the year 1900 epileptiform fits appeared

with maniacal excitation. To give an idea of the excitability of his brain, I may mention that in the course of an experiment to measure the electrical resistance of his head with a current of 2 milliamperes, he was seized with spasms. Later I applied leeches and he bled for three days.

On January 20, 1904, I had two profile diagrams taken with the Roentgen rays by Dr. Kienboeck. As the diagrams are too delicate to be reproduced for printing by photographic means, I had drawings of them made from the negative and from the sensitive side of the plate. In this way the impenetrable parts appear clear and vice versa. I will recall that I call the clear parts "shadows" and vice versa. The drawing is made three-quarter side.

On the diagram of the right side (Fig. 1) is the "shadow" of the whole osseous circumference enlarged and the outline of the brain pressed in, as *a* and *b*. The frontal cavity is small, evidently through ossification of its walls.³

Instead of two narrow shadows of the bilateral uppermost edges of the roof of the orbita *ob*, such as we generally meet with, we see the whole spot *p* as a large shadow, in which we can distinguish a shadow, *g*, which is evidently the lowest and most anterior part of the sinus longitudinalis. This large basal shadow (*p + ob + g*) indicates a pathological process in the base of the anterior cavity of the skull, and certainly the same process which enlarges the shadow of the osseous circumference.

One sees a small focus *c* in the region of the central brain-lobes near the base. At *si* one sees the lowest and most posterior part of the sinus longitudinalis. When this part appears so distinctly, it may be a sign of a pathological state. Among other details visible are the eth-

moidal cavities *s*, the sphenoidal cavity *k*, the external auditory canal *au*, and the sella turcica *st*. The arch, *tb*, marks the anterior part of the pyramid, *P*, of this side and one sees behind it a little elevation as representative of the highest point of this pyramid, which I call the colliculus pyramidis. Behind appears the elevation of the other pyramid, which reaches the point *cl*; its connection with *Py* is not distinct in the reproduction. One sees farther the processus mastoideus *ma*, the processus styloideus *sty* and the maxilla inferior *ki*. *β* marks the bregma and *po* the prominentia occipitalis externa.

On the left side (Fig. 2) we have nearly the same relations of the osseous circumference of the brain with the depressions of the outlines of the brain in *a*, *b*, *c*.

The frontal base, which we have marked *p* on Fig. 1, is still more developed in the abnormal sense than on the other side. *g* marks the same part as in Fig. 1. Between *g* and *ob* nearly the whole spot is shadow, though not well marked in the reproduction. The frontal cavity is very narrow through the thickening of its osseous walls. At *st* is seen the anterior part of the pyramid of this side and the little elevation behind it. Below this elevation one sees the cavities of the labyrinth (*sz* and *ch*); the first may mark a semi-circular channel and the second *ch* the cochlea or the vestibulum. Behind this small elevation of the pyramid on this side appears the higher elevation of the pyramid of the other side *Py*; *au* marks the meatus auditorius externus, *si* the posterior and inferior part of the sinus longitudinalis, and *St* the sinus transversus.

An important feature found in this plate is a great focus, *C*, approximately in the auricular transversal section, nearly 6 cm high and in its greatest breadth 5 cm, being 4 cm below the upper circumference of the brain, and hav-

³ This cavity is not well indicated in the reproduction.

ing a zigzag form. The processus mastoideus, the meatus auditorius externus, and the meatus auditorius internus *ch*, are also visible. The sinus transversus is marked by *St* and the posterior part of the sinus longitudinalis by *si*. β marks the bregma, α the posterior end of the fissura sagittalis and *po* the promontoria occipitalis externa.

When we ask what pathological process we must assume in this case, the answer is a pachymeningitis, especially hæmorrhagica, with all its consequences, also an alteration in the osseous parts. The enlarged shadow of the osseous circumference is not principally the result of thickening of the bones, but is produced also by pachymeningeal deposits. The same will be the case for the enlargement of the basal shadow, *p*. The foci in both plates are produced with the greatest verisimilitude by peripheral pachymeningeal deposits on the lateral parts of the surface of the brain.

From the clinical point of view one could suppose here the existence of an abscess; from the optical point of view we have no such evidence.

Case 2.—Bornstein, Marcus, met with an accident December 24, 1903, while entering a railway car not yet lighted. He fell over a trunk and received a contusion on the tibia and on the index of the left hand.

The nature of this accident seemed to point to a light lesion. To my great astonishment at the examination (January 4, 1904) serious symptoms were found. Standing with open and closed eyes the patient oscillated forward and to the left side. The supra and infra-orbital nerve of the left side were sensitive to pressure and the lateral frontal and temporal bones sensitive to percussion. In these localities the patient felt pains when he walked. The turning of the head excited pains, more toward the left than to the right side. The cervical and dorsal vertebræ were sensitive to pressure, the sensitive-

ness involving not only the processus spinosi, but also the lateral walls of the vertebræ on the left side. The pupil reflex was also feeble.

The plexus cervicalis superior and the muscles and bones of the left arm were sensitive to pressure, but this sensitiveness was not manifest in the nerves. The movements in the shoulder joint excited pain. The sciatic nerve and the n. cutaneus femoris externus of the left side were also sensitive to pressure.

The left arm and both legs, especially the left one, were adynamic. The patellar reflex was feeble, and especially on the left side. The left ear was more sensitive to the tuning-fork from the air and from the bones of the head. I was yet more astonished when Professor Reuss found beginning bilateral papillitis n. optici. The range of vision was much diminished concentrically, and in the left eye there existed a complete defect of vision in an inferior and superior sector.

In this case the diagnosis was justifiable that there were serious anatomical intracranial lesions and, as the case was a recent one, also blood effusions. Radiographs confirmed this diagnosis, as the following two figures prove.

I had two complete profile pictures made, but in the figures only the characteristic parts are drawn. On the right side (Fig. 3) there is a great focus, *c*, in the parietal lobe and extending into the occipital. The focus reaches approximately the base in the region of the pyramid. The pyramid of the same side is indicated by *st*, and that of the other side by *Py*.

On the left side (Fig. 4) there is a focus, *m*, which is situated in the upper part of the occipital lobe and occupies also a great part of the posterior position of the parietal lobe. This focus may have provoked the papillitis n. optici. *T* marks the sinus transversus (not well reproduced in the figure).

I will remark here that I have ob-

served papillitis in a severe case of railway accident, with amblyopia, which disappeared in course of time, though today, after 20 years, there remains ataxia, a great number of other serious cerebral and spinal symptoms having ceased. In another case I observed a fatally progressive atrophy of the optic nerve. Both cases are published in my paper: "Spätsymptome bei traumatischer Neurose," *Berliner klinische Wochenschrift*, 1888, No. 52.

Case 3.—A lady in her thirtieth year experienced seven years ago, at the end of a pregnancy, partial convulsions in the right lower extremity. The next year, under the same circumstances, the convulsions were repeated, with the difference that the convulsions appeared also in the right lower extremity, then extended to the arm, and finally to the whole body, loss of consciousness ensuing.

These fits have persisted since that time and during recent months have become more frequent. The radiograph in profile showed on the left side (Fig. 5) a focus, *c*, in the region of the central convolutions, but not reaching the surface of the brain. On the other side there was no trace of such a focus. This focus corresponds completely to our knowledge of the extent of the pathological alterations in such cases of convulsions. The anatomical nature of this pathological alteration is undoubted and consists in osseous stratification (depositions) on the inside of the skull.

Fig. 5 shows an alteration of the base of the anterior fossa cranii. The shadow *g* distinguishes the anterior and lower end of the sinus longitudinalis, ending in the large shadow *p*, which identifies a stratification of the base in the region of the crista galli and which joins with the shadow of the upper surface line of the roof of the orbita *ob*. This basal shadow is the effect of the stratification caused by pregnancy.

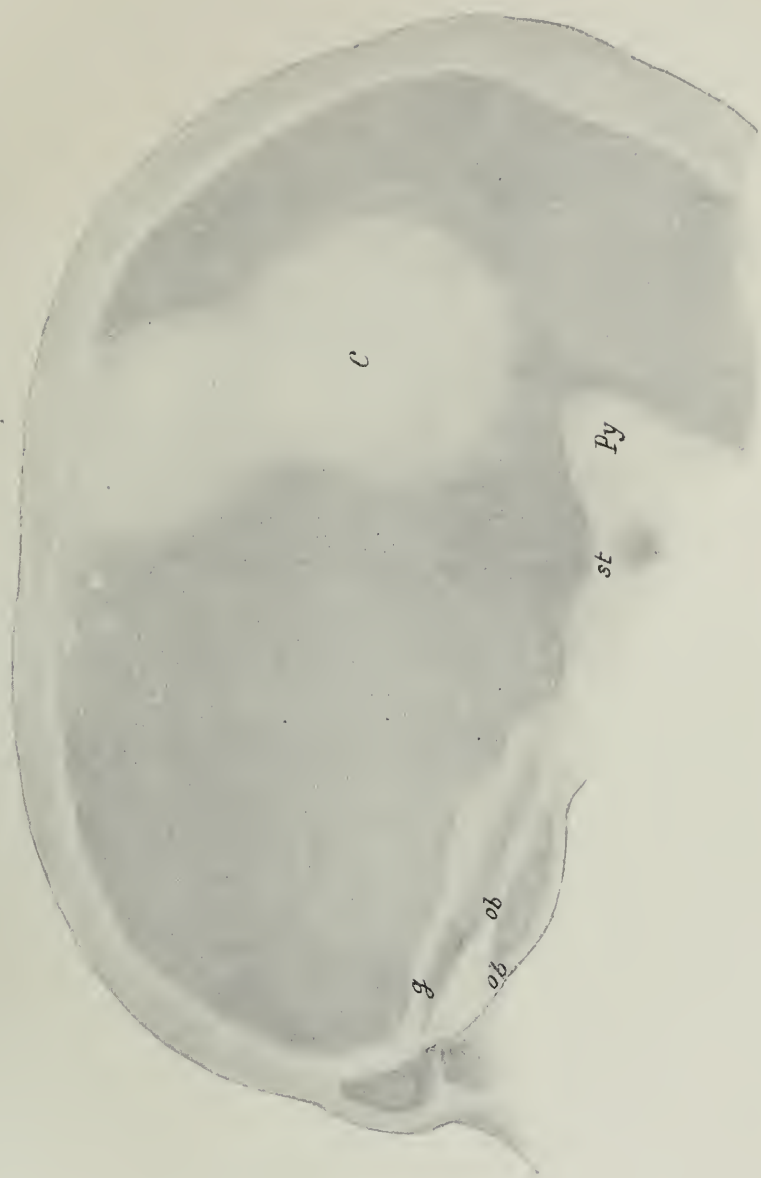
If one views more closely this master-

piece of Roentgen technics, a number of interesting details will be recognized. *s* points to the ethmoidal, *K* to the sphenoidal cavity. One recognizes under *tb* the tuberculum and under *st* the sella turcica of the sphenoid bone. In front of *tb* is seen the shadow of the processus clinoidei alæ minoris ossis sphenoidalis. Behind it begins the pyramid of this side and below its elevation are seen the three cavities of the labyrinth *sz*, which may be the three semi-circular canals. Near *Py* is the elevation of the pyramid of the other side. The shadow *T* signifies the sinus transversus, and *si* the lowest posterior part of the sinus longitudinalis. *β* indicates the bregma, *x* the posterior end of the sutura sagittalis, and *po* the promontia occipitalis externa; *au* marks the meatus auditorius externus and *ch* may mark the meatus auditorius internus. These cases must not be confounded with those of eclampsia intra partum, which are connected with albuminuria, and not with hysterical or epileptic fits intra graviditatem. The present case is a representative of a special form caused by osseous stratification on the surface of the central convolutions. We know that this anatomical process, which is common in pregnancy, shows very different degrees of intensity and localization, and has in general no clinical importance. Its involution varies greatly in intensity. When the involution is deficient, it may become serious, producing fits of epilepsy.

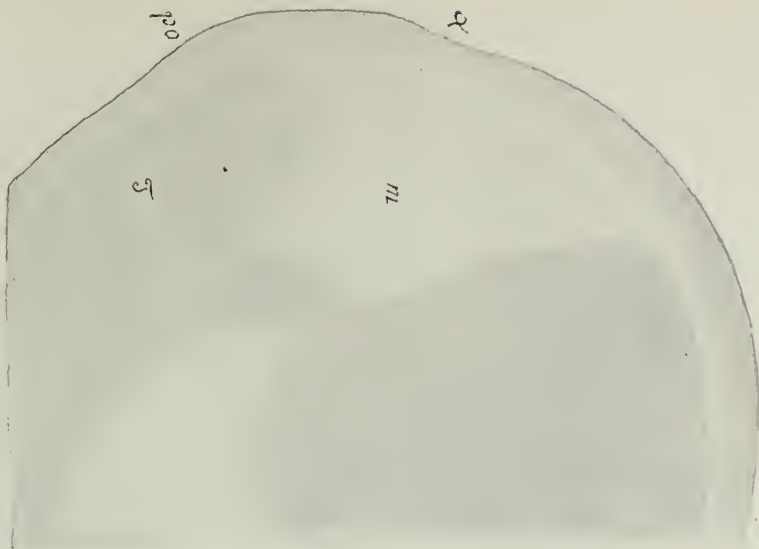
In my collection there are other plates of two cases of which I give below a short description.

The plates are dated 1902, the first May 20, and the other June 16. A comparison of these plates with those of the present day shows great progress. The difference between the second and the first pair is quite marked. The first pair shows an excess of dimensions, and they were taken without diaphragms.

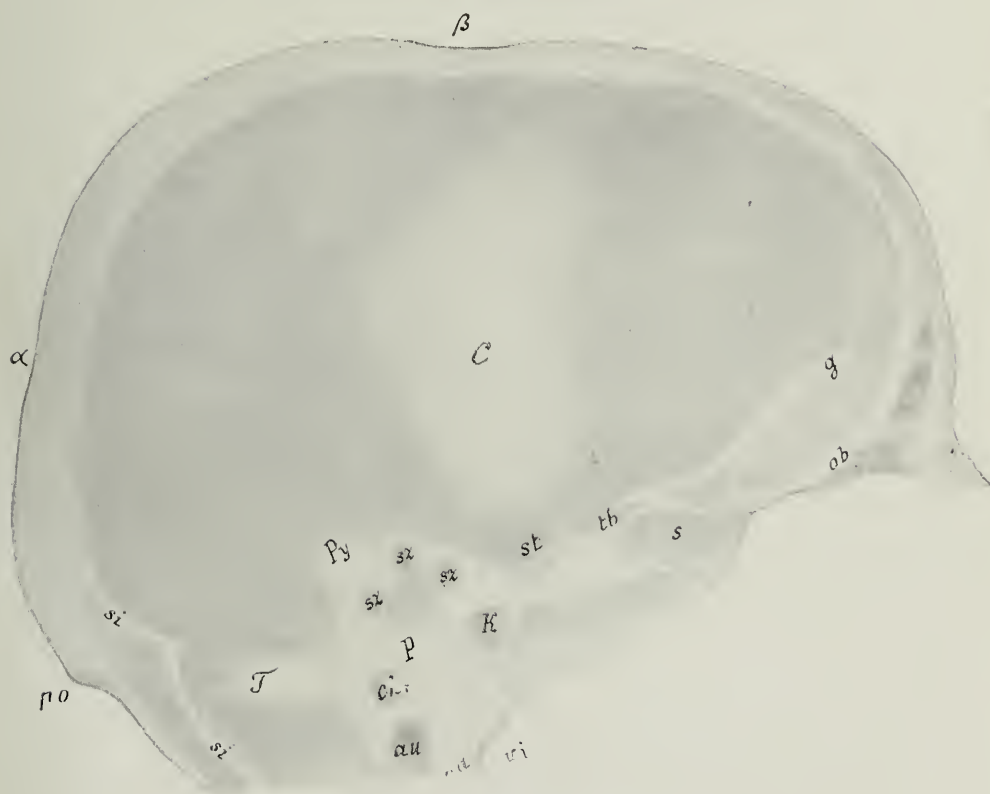
In the second pair appear the small intracranial cavities. Both suffered



DISEASES OF THE HEAD AND BRAIN — Figure III



DISEASES OF THE HEAD AND BRAIN — Figure IV



DISEASES OF THE HEAD AND BRAIN — Figure V

from the above-mentioned form of epilepsy through pregnancy with isolated spasms on one side, with supervention of general spasm on both sides, with complete loss of consciousness.

On the left profile picture of the first case (Kiesewetter) we observe first the whole osseous circumference enlarged. The same is the case with the base of the frontal cranial fossa. Within the frontal lobe there is a focus which does not reach the periphery and the inferior conical end of which nearly reaches the base. This inferior part of the focus incloses, in the form of a tiny island, brain-substance. In the parietal lobe is a great focus, which continues into the central lobe and reaches the base. The ethmoidal and sphenoidal cavities are unusually large, whereas the frontal cavity is very narrow.

On the right profile picture the osseous circumference, the shape of the frontal base and the dimensions of the ethmoidal and sphenoidal cavities, correspond to those on the other side. In the frontal lobe there appears a focus and a second one in the parietal lobe, which sends a branch into the lowermost part of this lobe to the periphery. The shadows are not as sharp as in the plates

taken later.

In the plates of the second case (Baruch), which are life-size, we see a very curious picture. The shadows by stratification seem to fight for space with the brain substance, so that we see islands of brain-substance surrounded by shadows. We also see streaks of the pathological substance forming a network between the brain pictures.

The osseous circumference is enlarged only in single parts of the periphery, and some parts of this osseous circumference are so thoroughly penetrated that we must suppose a secondary atrophy of those parts.

The plate is so perfect that we can see the cavities of the pyramidal and petrous portions of the temporal bone. The frontal cavity is very narrow; the ethmoidal and sphenoidal cavities are normal. On the left side the general shape within the brain-territory is nearly the same as on the other side, and on this side the form of network is still more decided than on the other. The osseous circumference is greatly enlarged in the occipital part, and the shadow of the anterior and of the posterior parts of the sinus longitudinalis is very marked.

DUPUYTREN'S CONTRACTION, WITH INDICATIONS AS TO TREATMENT*

BY WILLIAM JAMES HERDMAN, M.D., LL.D., OF ANN ARBOR, MICHIGAN.

AQUIRED deformities of the hand may result from a variety of causes, taking their origin in the skin, the fascia, muscles, nerves, ligaments, joints, or bones. Direct injury to a nerve or muscle or fascia may result in permanent contraction of the part affected. Severe burns or lacerations of the hand may result in cicatri-

cial contractions that distort and greatly impede the actions of the hand, producing at times permanent disability. But

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a not uncommon disorder that affects the tissues of the hand is an affection of the palmar fascia, which, by reason of the peculiar deformity it uniformly occasions, and from the surgeon who, among the first, accurately described its pathology, has received the name of Dupuytren's contraction.

This disorder is rarely seen in persons who have passed middle life, and, although cases have been found among women, it is in men that it is observed in the vast majority of instances. Slow and insidious in its onset, the first change that is noticed in the surface is a thickening or bunching of the integument in the palm of the hand in the line of one of the fingers, most frequently the ring or little finger. This elevated and hardened spot may be of the size of a small shot or split pea when first noticed, and upon pressure may prove slightly sensitive. It is commonly located as far forward as the third or distal crease in the palm. This little elevation may soon be followed by others of similar character, either in advance or behind it in the same longitudinal line, or to either side and slightly in advance of the original spot. The effect of these formations is to moderately constrict and fix the integument of the palm and render it less freely movable over the cutaneous tissue. Subsequently, in the line of the nodules, distinct bands begin to form underneath the integument. Usually a longitudinal one is first observed, which, upon an attempt at extension, can be distinctly defined extending to the palmar surface of the first phalanx of the affected finger, and at times it can be observed to have an insertion as far forward as the second, or even the third phalanx. (Fig. 1.) Before the longitudinal band has become very prominent, lateral bands, taking their origin from the longitudinal one, can be observed running off to either side, inclining slightly forward, and being lost in the bases of the digits of the adjoining fingers. This is the usual

order of changes and the appearances observed as the deformity progresses; there may, however, be frequent variations from it. Instead of one, there may be two or even more longitudinal bands, while the transverse bands may be almost entirely wanting; again, the transverse bands may be developed out of proportion to the longitudinal ones. As soon as these bands become prominent, the patient finds it quite impossible to extend the bridled finger, and this attempt is in no respect more successful when the hand is flexed at the wrist upon the forearm, as is the case when the finger contraction is due to shortening of the finger tendons. The degree to which the finger or fingers may be drawn down upon the palm varies in different persons, and according to the duration of the disease in each case. In some cases there is but slight impediment to the power of extension, while in others the contraction has steadily progressed until the nails of the fingers are buried in the tissues of the palm. It is remarkable that certain fingers are much more liable to this form of contraction than others. From statistics drawn from a hundred cases which I have been able to collect, some ten or twelve of which have occurred in my own practice, the following facts have been derived:

The ring finger contracted 93 times.

The little finger contracted 79 times.

The middle finger contracted 45 times.

The index finger, 15 times.

The thumb, 9 times.

The ring finger contracted alone 18 times.

The little and index fingers each alone 4 times.

The thumb alone, never.

The most frequent combination was that of the ring and little finger, which occurred 67 times, while the ring, middle and little fingers were together involved in the contraction 17 times.

Usually it is the first phalanx of the



DUPUYTREN'S CONTRACTION—Figure I



DUPUYTREN'S CONTRACTION—Figure II

finger only that is constricted, so that the affected finger can be fully extended, except at the metacarpo-phalangeal joint. Yet in seven cases it was found that the second phalanx alone was involved, while in six cases the contracting bands extended to all three phalanges of the affected fingers. There seems to be but little distinction as between the right and left hand. Out of seventy-five cases the right hand alone was involved 24 times, the left hand alone 13 times, both being involved 38 times. The right hand was affected therefore 62 times, the left 51.

When both hands are affected I have noticed a remarkable symmetry in the fingers involved, the only difference being the less degree of progress in the left. All observers have not, however, had this same experience, for some record considerable variation as between the two hands.

In order that we may clearly understand the mechanism of these contractions, it will be necessary for us to examine, somewhat more in detail than the ordinary text-book description affords, the distribution of that structure in which Dupuytren found the pathological progress take its departure, and to which almost the entire changes producing the deformity are confined.

Normal Anatomy.—That layer of connective tissue which we term subcutaneous or superficial fascia, because of its uniform distribution immediately beneath the integument, varies in the amount and nature of its development owing to the function of the locality where it is found. The integument is more or less intimately connected with it by fibres from the connective tissue layer passing into and blending with the deeper layers of the derma. At times this union between the derma and the subcutaneous connective tissue is very slight, the connecting fibres few and slender and the underlying connective tissue itself open and lax, forming but an

indifferent layer, sufficient only for the proper support of the lymphatics, blood vessels, nerves, etc., that ramify in it; while the interstices between the fibres oftentimes contain cells stored with fat. In the more exposed regions, however, as the back of the arms, front of the thighs, etc., the integument and superficial fascia become more dense and thicker, and a closer union is observed between the integument and fascia, their connecting fibres being shorter, more numerous and stronger. In such localities as the soles of the feet and the palms of the hands, where, by reason of the functions of these parts, greater density of these protecting coverings is required, we find the superficial fascia greatly increased in thickness, and its union with the overlying derma still more intimate, while the deposits of fat in its meshes form no longer a continuous layer, but are gathered in little pellets, occupying the interval between the numerous fasciculi which connect the skin with the underlying dense layer of fascia. The palmar fascia is usually spoken of as composed of a *central* and *two lateral portions*. The central portion is narrow above, near the wrist, where it is continuous with the lower margin of the annular ligament, and is strengthened by the expansion of the tendon of the palmaris longus muscle; it widens as it extends toward the finger. Opposite the heads of the metacarpal bones, its fibres, thus far uniformly distributed, are now grouped, to some extent, into four slips for the four fingers, each slip again dividing opposite the metacarpo-phalangeal joint, and the divisions passing one on either side of the flexor tendons, and being inserted, for the most part, into the sides of the first phalanx and glenoid ligament; but on careful dissection fibres are found inserted as far forward as the lateral and palmar surfaces of the second, and even of the third phalanx, while the removal of the integument in the attempt to trace these

deeper fibres has severed the bands which served to unite the fascia to the skin throughout its entire expansion, which bands are found to be especially abundant over the ulnar surface of the palm.

Although the transverse fibres of the fascia forming this central portion are less numerous after the separate slips are formed for each finger, there is no complete interruption of them, and at the digital margin of the palm these transverse fibres form a distinct band stretching from the ulnar to the radial side of the hand. This band of transverse fibres give form and strength to the web of the fingers, and constitute what the French anatomists term the "fibres of Gerdy." Some of these fibres stretch entirely across the palm, while shorter ones join two or more fingers only. The longitudinal fibres of the central layer of fascia freely interweave with the transverse fasciculi. The lateral portions of the palmar fascia are thin and less continuous fibrous layers stretching from the central portion over the muscles of the ball of the thumb on the one side, and on the other covering the muscles of the little finger and being continuous, both on the ulnar and radial margins of the hand, with the fascia of the dorsal surface.

Pathological Anatomy.—It can be readily seen from this description of the arrangement of the several portions composing the fascia that any abnormal shortening of one or more of the longitudinal fasciculi of the *central portion* would result in traction upon the transverse fibres, the "fibres of Gerdy," and such of the fibres of the fascia as are inserted into the integument in the vicinity of the affected region. Slight contraction of the fascia would cause the little nodular bunches in the integument, while a more advanced state of contraction would result in the prominent longitudinal and transverse or crescentic ridges, with flexion of the first or even

second or third phalanx of one or more fingers, which are the characteristic appearances of the deformity when well established.

The opportunities for making a careful dissection and microscopical examination of these changes have not been many, but it seems to be the conclusion of Dupuytren, Goyrand, Adams, and others who have studied the pathological histology that change in the fascia alone may and does account for all the phenomena which these cases present.

In no cases where dissection has been made is any record given of contraction of the flexor tendons, while in ten cases at least it is especially stated that they were entirely normal.

Recently Nichols,¹ who has studied the histology of two cases in their early or developing stage, finds that the cellular and vascular elements are much more abundant at this period and that later the cells and vessels diminish, leaving the dense fibrous mass which has commonly been described. The hypertrophy of the fibrous tissues occurs especially along the course and in proximity to the small blood vessels. This author calls attention to the necessity for taking into account this fibro-plastic action and the abundant proliferation of connective tissue cells and their relation to their vascular elements in any attempt at an etiological explanation.

The skin, which to all appearances is thickened and hypertrophied at the seat of the ridges and nodules on the surface, and which has been assumed by many to be the real cause and starting point in the pathological changes, has been found, when freed from its attachments to the underlying constricting fasciculi, to be normal in thickness and microscopical structure. The apparent increase in its elements is wholly due to the density produced by the constriction and the absorption of the underlying deposits of fat, which no doubt atrophied by reason of the compression to which

they were subjected. The changes, therefore, are thus found to be confined to the fascia alone, and consist in shortening and hypertrophy of irregular bundles of fasciculi, which take their origin from the fascia and have an insertion quite variable, some in the skin of the palm or palmar surface of the digits, others into the tendinous sheaths, while others are inserted into the bones of the digits, either laterally or as far as their dorsal surface. It is not necessary to assume, as some have done, that any of the normal fibres of the fascia are found distributed in all the localities where these thickened bands have been observed.

Diagnosis.—An accurate knowledge of the normal distribution of the palmar fascia and its manner of attachment to contiguous parts ought to prove a sufficient safeguard against any mistakes as to the tissues involved in this deformity, and indicate to the surgeon or physician the proper course to be pursued in treatment. Yet in certain of our surgical works of today, and not infrequently in the minds of good surgeons, are erroneous opinions expressed both as to the pathology and treatment of this affection. The most common error that is committed in diagnosis is the assumption that the deformity is due to contraction of the flexor tendons, and treatment based on this assumption has not in a few instances proved disastrous, while, on the contrary, treatment has been withheld by reason of this error, which might, if properly applied, have greatly contributed to the comfort and efficiency of many sufferers.

It is not necessary to dwell upon the differential diagnosis as between contraction of the flexor tendons and the palmar fascia, after the minute description that has been given of the anatomy of the latter, but it will suffice to say that at the point where the prominent ridges are observed in the palm in cases of fascia contraction, no such appearance could

be produced by contraction of the flexor tendons, for the reason that they are so firmly bound down to the bones at this point, by the strong fibres of their enveloping sheaths, that the most extreme flexion of the fingers never results in a prominence of the tendons. Again, contraction of the flexor tendons by reason of this insertion to the second and third phalanges of the fingers would primarily cause flexion of these phalanges, while in the vast majority of instances it is the proximal or first phalanx that is flexed in contraction of the palmar fascia, and no position of the hand will permit of its being extended.

Etiology.—In spite of the careful researches that have been made with the view of determining the etiology of this diseased condition, no very satisfactory conclusion has yet been reached.

Age, as we have seen, is an important factor, for in the vast majority of instances on record the deformity does not appear before the age of 50 years. In one of my cases the patient was 55, in another 65, another 73, while the others ranged between 50 and 70.

Sex also seems to play a part in the causation, since the deformity occurs in the male ten to one as compared with the opposite sex.

Occupation does not seem to have any share in determining the result, since the deformity has been observed in all conditions of life, the laborer, the mechanic, the shop-keeper, and the professional man being affected with almost equal frequency. From this it would appear that the cause to which this deformity has been so commonly assigned, that is, a succession of mild injuries to the palm by reason of the manual employment in which the patient has engaged during the active period of life, cannot be allowed much weight. Yet in some cases that have come under my observation I have thought that irritation from peculiar kinds of manual labor, such as caused frequent and undue

pressure on the palmar fascia, if not the chief cause, may have acted in the rôle of an important accessory cause. My impression agrees with that of most observers also in that the greater number of those whom I have seen as sufferers from this affection have belonged to the professional class. The majority of observers agree in the opinion that a *gouty or rheumatic state* is the more common etiological factor to be observed in these cases. In the records that I have been able to examine, in about fifty cases where the constitutional conditions were mentioned, gout was positively indicated in at least forty-five, while rheumatism seems to prevail with almost equal frequency. In my own cases, although in but one instance was the patient affected with decided rheumatic attacks, yet in all the rheumatic diathesis was well marked by occasional lumbago, muscular and joint soreness, and an excess of uric acid deposits in the urine. It is a noteworthy fact that the contraction much more frequently takes place over that region of the palm supplied by the ulnar nerve, and perhaps in the exposed condition of this nerve to rheumatic irritation, especially in the vicinity of the elbow joint, we may discover an important element in the causation. Neuritis of the ulnar nerve in its course above the hand and in its palmar distribution as well has been frequently noticed in the progress of this disorder, and the disturbed nutrition occasioned by the nerve irritation might well account for the onset of the subacute inflammation in the fascia. Adams calls attention to the frequent involvement of the expanded tendon of the palmaris longus in the affection, and cites this in support of the opinion that nerve irritation may be present as a cause in some instances, at least. In addition he claims that the facts of an evident hereditary tendency, the frequent occurrence of the contraction in both hands, and the large preponderance of cases among the well-to-do

and professional classes favors the view that the fibrous increase has a gouty or rheumatic origin.

My own experience convinces me that the preponderance of evidence as to the etiology of this disorder sustains the opinion that we have to do with a subacute inflammation of the subcutaneous connective tissue elements, resulting in an hyperplasia of these elements and subsequent cicatricial contraction of the new formed tissue. The disorder seems to have a very close relationship to that constitutional state, either rheumatic or gouty, which by a slow process of nerve and other tissue irritation issues in subacute inflammation, distorts the nutritive process and creates deformities in the small joints and bones of the hands and feet.

I look upon these fascial changes in Dupuytren's contraction as but one of the expressions of a constitutional diathesis, nutritional or rheumatic in nature, in which an irritant present in the fluids of the body, and due in all probability to incomplete metabolism, is the cause of subacute inflammation of the connective tissue elements. The nerve irritation if not antecedent to the connective tissue inflammation, a view to which I incline, is nevertheless an important factor in maintaining the hyperæmia that feeds the inflammatory process.

Treatment.—If the opinion here expressed as to the etiology and pathology of these fibrous contractions is the correct one then the treatment of the local condition is but an incident in the proper management of such cases. A course of anti-gouty or anti-rheumatic treatment is indicated, and should be maintained with the purpose of freeing the system from the irritating effects of the crude waste products with which the fluids of the body are loaded. Aside from the customary remedies for this purpose, I, in common with many others who are making daily use of the

aid which electricity can render, employ it in cases of this nature with a view of bringing about a more complete metabolism in the products of tissue waste. The electric energy is transformed into the chemical and mechanical forms of energy needed in the system to bring about this result, the tone of the muscular tissue is heightened, thus promoting more prompt and complete removal of effete products, and the nervous action is stimulated. For this general stimulating, toning, and transforming action the high tension forms of electric energy seem best adapted, and it matters little whether these be obtained from the static machine, the Rhumkorff, or the Tesla coil, or from self-induction in the alternating magnetic field after the method of D'Arsonval, Piffard, or that employed by myself. The old-time methods of "general galvanism" accomplish the same result if they are persistently and faithfully made use of, but they are slower in effecting the required changes in tissue action and much less convenient in application. As for the local deformity, it can be dealt with in a variety of ways. (Fig. 2.) The surgeon has the choice of the subcutaneous method of severing the constricting bands, as strongly advocated and practiced by Adams of London, or the open method of dissection which Tubby² advises. It has always seemed to me much more natural and scientific to counteract these cicatricial contractions if possible by some method which will not repeat the very process of hyperplasia which has been the cause of the contractions in the first instance. A surgical injury, no matter how aseptically and skillfully performed, is followed by the processes of repair, and a large share of these consist of an increase of connective tissue cells and formation of new cicatricial tissue from them which in many instances results ultimately in as bad if not worse state of contraction than that which first obtained.

We have in the action upon living animal tissues of the direct electric current of suitable strength a series of effects which seems to me most admirably adapted to meet this tendency to cicatricial contractions in fibrous tissues. When the negative electrode conveying a current of this nature, of a few milliamperes strength, is brought into contact with the tissues the alkaline constituents of the tissues are increased in the vicinity by electrolysis and the fluidity by phoresis. A softening of the new-formed tissue is thus brought about, its disintegration is favored, absorption of the excess takes place and a return to the normal amount of connective tissue belonging to the part is effected. This is a simple fact in the action of the direct current upon cicatricial tissue which is of practical value wherever it is intelligently and skillfully employed, and has a wide range of efficiency in many disorders which are now dealt with by surgery, in what appears to me a most bungling manner. I refer especially to those disorders which are known as *strictures*, due to inflammation, hyperplasia, and subsequent contraction of the submucous connective tissue lining the various tubes and passages of the body, such as the urethra, the Eustachian tube, the nasal duct, the uterine cervical canal and the like.

The hyperplasia of the palmar fascia with its subsequent contractions can be counteracted in this manner and the deformity prevented or removed—but it requires patience and persistency on the part of both physician and patient and faith and skill in the method. The cutting operation is more impressive, more spectacular, but if we keep in mind the ultimate result and the best interest of the patient the electric method has the most to recommend it.

There are, of course, accessory measures that it is advisable to employ both for the benefit of the constitutional and the local state, such as diet, hot baths.

oily embrocations, massage, and probably in some cases properly adjusted splints with the view of maintaining moderate counteracting tension upon the constricting bands; but these are not

in themselves curative.

References:

¹ N. Y. Med. News, 1899.

² London Lancet, Jan. 12, 1901.

REMARKS ON HIGH FREQUENCY CURRENTS AND THEIR THERAPEUTIC ACTION *

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THAT high-frequency and high-tension currents could be produced, was first pointed out by Henry in 1842, and that the discharges from the Leyden jar were oscillating under certain conditions was asserted by Von Helmholtz in 1847. By experiments with the electric spark, Feddersen, a Danish physician, in 1850, found from the reflection in a rotating mirror that the spark discharge stopped and recommenced periodically; he calculated that the period of these oscillations was about one one-millionth of a second. In 1888 Heinrich Hertz, a German investigator, found that by passing sparks from an induction coil through a spark gap between two polished balls, ethereal waves were set up which traveled in all directions; these were detected by means of a circle of wire with a small spark gap, in which, when the ether waves were passed through the ring, electrical vibrations became manifest, causing small

sparks to be discharged across the gap of the circle of wire. This circle of wire is called a resonator.

The phenomenon of resonance is illustrated by the experiment of Sir Oliver Lodge, whose recent lectures are reported in the Archives of the Roentgen ray. Two Leyden jars are placed near together, one being connected to a static machine. A bent wire connecting the inner lining of the jar to within a short distance of the outer coating makes a spark gap, and the two wires from the static machine are connected by a cross piece of wire to slide back and forth so as to adjust the inductance.

The second jar has a wire connected to the outer coating, and bent to approach the ball connected to the inner lining of the jar, forming a second spark gap. The discharge of No. 1 jar sets up a discharge from jar No. 2.

The primary current coming from either an alternating circuit or motor generator is put through a transformer, which increases the voltage to 10,000, 30,000 or more volts; this is discharged by condensers through a spark gap. This is the primary current of a secondary coil. This primary alternating current of high frequency induces a secondary alternating cur-

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rent of both high frequency and high tension. This high tension penetrates most of the insulating materials, such as rubber and glass. The size of condensers, length of spark gap, and length of primary coil all change the high frequency, and the secondary wire has to be "tuned" to the rate of oscillations or time frequency. The whole apparatus has to be in "tune," or *resonance*, to get the best effect.

The larger the size of primary wire the less the impedance, thus preserving the high voltage, and the number of turns of the secondary wire gives us the high tension. Freund, in his book, page 162, says: "There is no hard and fast line to be drawn between the biological effects of static, faradic, and high-frequency electricity. Any differences which may exist depend simply upon the strength of current employed in any particular instance. The effects are mechanical, electrolytic, and thermic." The three principal methods employed in obtaining electrical currents of high potential and great frequency are, first, by means of the D'Arsonval solenoid, second, by the use of the Oudin resonator, third by the Tesla coil, or some modification of it. A short description of these methods is in a former article published in the March number of the *Advanced Therapeutics*. The foreign specialists condemn the Tesla system on account of the output of such a large amperage without suitable means for controlling it. This has now been remedied, and there are now two coils on the market which seem to me superior to the other two systems, being more compact and more general in their application.

According to Hertz, nerve fibers will respond when excited by electrical stimulus at the rate of 6,000 to 10,000 vibrations. The extreme frequency produces no impression on motor or sensory nerves, because of the extreme rapidity of vibration, reaching into hundreds of

millions per second. This current has a penetration and a marked effect on the circulation by its molecular bombardment, which has its beneficial effect on congestions, either acute or chronic, and errors in metabolism, increasing the elimination of uric acid and CO_2 , increasing the production of heat, retarding the growth of parasitic diseases and decreasing the virulence of the toxins which these bacteria produce. Dr. G. Herschell of London says: "The key to the understanding of the effects of the current of high frequency is to remember that they can be made to exercise a manifold action: viz., to increase metabolism, to allay sensibility, to stir up the sympathetic system of nerves, and increase or diminish the functions of glands; to tone up unstripped muscular fiber, and incidentally to act as a general tonic."

Patients who have taken other forms of electrical treatment may say "they are not getting anything," but can be convinced by approaching them with a vacuum electrode, when they are holding a metal electrode connected to one of the poles of a high-frequency machine, whereupon the tube will light up, showing them to be surrounded by the waves of current. The high-frequency treatment is more pleasing to the patient as compared with the static, because of the absence of the pain which accompanies the sparks derived from the latter machine. The patient seems to recover more rapidly with the high-frequency treatment than with the static; after the treatment usually speaks of feeling sleepy, showing its sedative effect, and there is moisture in the skin, showing increased action of the sweat glands set up by the molecular bombardment. Pressure from congestions is relieved and cases of malassimilation show marked improvement under its action.

Chronic rheumatism, arthritis, neuritis, neurasthenia, constipation, hemorrhoids, tuberculosis, herpes, eczema, salpingitis, and cervical erosion (one case

of twelve years' standing that showed signs of breaking down into carcinoma) are cases which I cured by its application either by the effluvia or the vacuum tubes.

Case 1. — Mrs. A., age 52 years, salpingitis with chronic metritis, patient sent to me by her physician, had had curretage for flowing, March 1901. May, 1903, was examined by Dr. Maurice Richardson, who was called in consultation; he advised against operation. August, 1903, was curetted a second time, but these operations did not stop the flowing for any length of time. She came to me January 10, 1904, when I used the continuous current 35 volts 25 to 30 ma. Apostoli int. uterine electrode as the positive pole, with large abdominal pad 150 c. m. for the negative pole, treatment once or twice a week with varying success until April 16th. On April 30th, I used a copper-tipped intrauterine electrode positive pole, with the same size pad as in previous treatment, for the negative pole, twice a week for six treatments, and she has had but one discoloration since; but complaining of pain in the region of both ovaries, especially the right one, I began using the ovarian ball electrode as positive pole with the pad over the ovary, and this treatment would relieve the pain for some hours after each application.

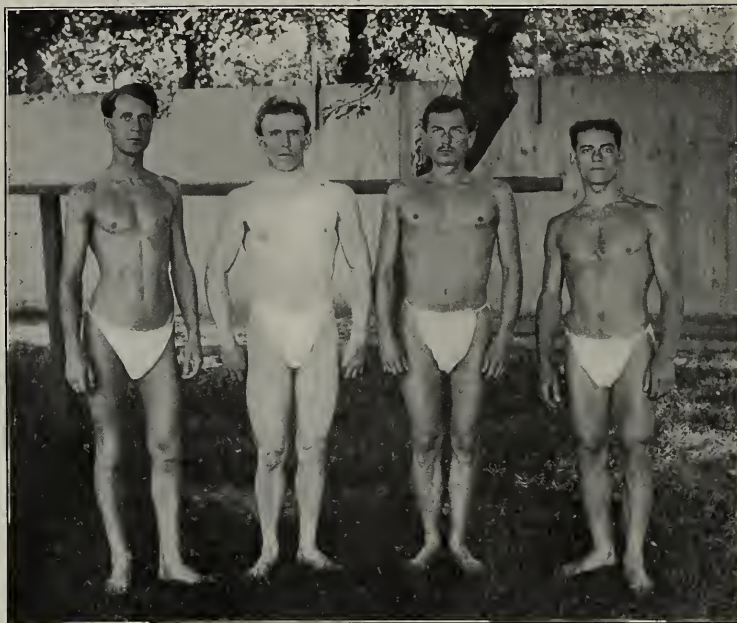
June 25th I began with the high-frequency current, using a special vaginal vacuum tube attached to one pole of the machine, while a second vacuum tube of the flat disk type was used over the ovarian region, running the current as long as it could be borne, say 5 to 8 minutes; this was continued twice a week, the patient receiving in all 13 treatments.

The flowing and pain was stopped and the patient says she is "feeling fine."

Case 2. — Congestive headache with insomnia. Mrs. B., 39 years, had been subject to these occipital headaches for about nine years, some time after her first childbirth. Had fibroid tumor re-

moved in 1901; another was discovered in April, 1903, when uterus was removed, thinking these headaches would cease. She had been to two nerve specialists, and bleeding had been resorted to with benefit at time of attack; these continued at intervals of 3 to 4 weeks, but this treatment could not be continued each month, and morphine had been resorted to. She was sent to me by her physician, June 2, 1903, when in one of her attacks. I used the high-frequency current with vacuum tube, giving a counter-irritant effect, which enabled her to sleep until 4 o'clock that night; the next day I repeated the treatment and she slept all night. June 4th, her third treatment relieved for a month, when she appeared July 3d, one treatment, again July 28th, one treatment, when I went on my vacation. She returned in November, being treated November 18, 23, 24, 25, and 28th; December 2, 5, and 9th, thinking more treatments would effect a cure. She was free until February, when one treatment relieved. I found family difficulties were the probable cause of her attacks; a permanent cure under the circumstances was impossible. I cite this case simply to show how easily the attacks were aborted.

Case 3. — Neurasthenia with marked cerebral congestion. Miss C., 32 years, who had worked in a large publishing house since she was 17, broke down four years ago with constant throbbing at the head, and for the past two years was subject to frequent crying spells, could not close her hands, and while she could stand was unable to walk without falling. Was sent into the country for five months and later had treatment with the static machine for some months, when she was sent to me by the physician who then had her under treatment. I began with the static, November 10, 1903, and gave her treatments every week day until December 1st. As she did not seem to be gaining, I used high frequency over occiput and spine in ad-



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dition to general static treatments. On January 11th, I continued the high frequency alone until January 16th, then the treatments were three times a week until April 1st, then twice a week, ending July 28th. The eyes were markedly congested, which were relieved by the vacuum eye electrode. The high-frequency treatment was with vacuum

tubes over occiput and spine, also over stomach and bowels.

I cite these three cases as being the most severe I had during the past season. These being cases in which other forms of electrical treatment had been used, but after trial I was compelled to end up with high-frequency current.

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BY J. H. KELLOGG, M.D., OF BATTLE CREEK, MICHIGAN

I SHALL not in this paper undertake to present a resume of what is known respecting the influence of light upon the bodily functions or even summarize our present knowledge of the therapeutics of light. My purpose is only to present a brief note to record some of my own observations.

I began nearly thirty years ago the use of the sun-bath as a general vital stimulant in the treatment of chronic maladies. I confess that my first efforts were quite empirical. I was led to employ light baths through the fact that they were so highly prized by the ancients, recommended by Hippocrates and by various other Greek and Roman medical writers. When traveling in Italy and old Mexico I observed that the poorly-fed peasantry showed great fondness for exposing themselves to the direct rays of the sun. I also observed that dogs, cats, and other animals did

the same. Sunlight appeared to me to be a natural agent which might be utilized; and, as I had chosen physiologic medicine for my specialty, I laid hold of this as one of a group of natural curative agencies which might be employed in combating disease.

The discoveries of Helmholtz and other physicists respecting the nature of light, and especially the more recent researches of Finsen, Siemens, Hervé Mangon, Bailey, Deherain, and other investigators respecting the physiological effects of light, have provided for phototherapy a thoroughly rational basis. I shall not tax your patience with a recapitulation of the important facts which have been developed by these researches and observations. I desire especially to call attention to a therapeutic principle which so far as I know has not been definitely recognized in phototherapy, namely: the therapeutic value of the effect produced upon the skin by the actinic rays of the sun, of the electric arc, the incandescent filament, and other incandescent bodies.

One of the effects of heat upon the skin is to dilate the peripheral vessels. Just how this is accomplished it may not be possible to explain with certainty.

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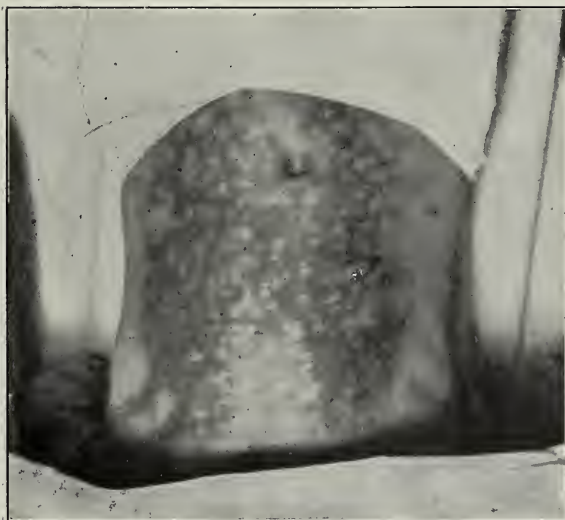
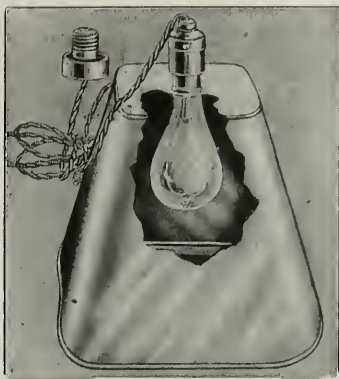
The most recent and most plausible theory is that there are in the small vessels longitudinal as well as circular fibers which by contracting serve to increase the lumen of the vessels. This effect is produced by heat applied to the skin in any manner or from any source, as by means of a hot bath, a heated object brought into contact with the skin, hot air, and heated vapor, as well as by heat in the form of radiant energy; but radiant heat is unquestionably more effective than any other in producing this dilatation of the vessels through its greater penetrating power. The rays of energy pass through the skin and penetrate to a considerable depth, being converted into heat as they meet with resistance. A more rapid and profound effect is thus produced by the heat of the sun, or from an arc light or incandescent filament than by thermic applications of other sorts.

Another important effect produced by heat is nervous inhibition. Acting through the temperature nerves, heat lessens nervous irritability and thus becomes one of our most precious means of combating pain. The same inhibitory influence may be employed as a means of lessening functional activity in an overacting organ. It is for this reason that we apply heat for the relief of spasm, as in colic and muscular cramp, and to produce muscular relaxation by lessening the excitability of the muscular tissue, so lowering its "tone." The general depressing effects of heat, which are easily made manifest by a hot bath, are well known. The fomentation owes its value as a means of relieving pain in many cases to this inhibitory effect, as in neuralgias, and especially in visceral neuralgias.

The effects of heat above mentioned are of course temporary. The vascular dilatation rarely persists more than an hour or two after an application of heat, no matter how prolonged, and not infrequently is followed by a contraction

of the vessels and very pronounced anemia. This may be due either to the chilling of the surface from evaporation of the moisture which is always present in increased amount in consequence of the stimulation of the sweat glands, or to the natural reaction which follows over-stimulation of any sort, or both influences combined. The inhibitory effect produced by heat is also more or less transient. Nevertheless, both these effects are exceedingly valuable, and, as I shall show further, presently, the effect of solar heat and heat from other luminous sources in dilating the vessels of the skin is of immense therapeutic importance in dealing with chronic maladies.

A more intense and permanent effect upon the cutaneous vessels is produced by the actinic ray of sunlight and the arc light when applied with sufficient intensity to produce so-called sunburn, or *solar erythema*. The intense reddening of the skin, which appears usually within ten or twelve hours after a sufficiently prolonged exposure to intense actinic rays, is evidence of complete relaxation of the vessels of the skin and filling of these vessels with blood to an extraordinary degree. The skin is capable of holding, when these vessels are fully distended, one-half or two-thirds of all the blood in the body. This fact sufficiently emphasizes the difference in the volume of blood contained in an anemic skin and one in which the vessels are fully distended. The therapeutic significance of this fact lies in the influence which congestion of the skin exercises upon the blood volume of internal parts. If the blood supply of the skin is within a short time increased from a small fraction of the total blood volume to one-third or one-half of the whole amount of blood contained in the body, it is evident that we possess in artificial congestion of the skin a method whereby we may quickly withdraw from the great vascular organs of the trunk



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from one-fourth to one-half of their total contents, thus affording almost instant relief to a congested liver, engorged spleen, hyperemic lungs, inflamed stomach or intestines; or congested spinal cord.

Careful study of the blood supply of internal organs in relation to the skin shows that the blood vessels of every important internal organ are very directly connected with the vessels of the skin, either arteries or veins, or both, so that it is possible to produce effects by means of local as well as general hyperemias of the skin, thus inducing collateral anemia of vascularly related parts. In my work on hydro-therapy, and in my chapter on thermo-therapy in "Cohen's System of Physiologic Therapeutics," Vol. IX, I have summarized the facts which I have been able to collect respecting the vascular relations of the skin with internal parts, and I take the liberty to quote from the last-named work the following paragraphs:

"The vessels of the brain are freely connected with those of the scalp and of the nose through the parietal foramen, the foramen cecum, the mastoid foramen, the posterior condyloid foramen, the foramen of Vesalius, the foramen ovale, the foramen lacerum medium, the carotid canal, the anterior condyloid foramen, as well as through the diploë of the cranial bones.

"The meningeal veins, which form dense plexuses in the spinal canal, are freely associated with the cutaneous veins of the back and with the dorso-spinal veins through the anastomosing veins which issue from the canal through the intervertebral foramina, and unite with the intercostal, vertebral, lumbar and sacral veins.

"The blood-supply of the eyelids and of the skin covering the eyebrows and adjacent portions of the forehead is collaterally related with the branches of the internal carotid which supply the

eyeball.

"The circulation of the middle ear is collaterally related with the circulation of the skin of the face and head of the same side through the common carotid. The circulation of the internal ear, on the other hand, is associated with the skin of the back of the neck, being derived from the vertebral arteries.

"The vessels of the mucous membrane of the nose and pharynx are associated with those of the face and the sides of the head through the common carotid.

"The circulation of the lungs is collaterally related with that of the skin covering the arms, the chest and the upper part of the back. The pericardium and the parietal pleura of the anterior portion of the chest are collaterally related with the skin covering the anterior portion of the chest wall through the internal mammary artery.

"The parietal pleura of the posterior portion of the chest and the visceral pleura are collaterally related with the intercostal vessels. A collateral relation also exists between the bronchial arteries, the nutrient arteries of the lungs, and the intercostals, especially those of the right side. The skin covering the arms is collaterally related with the pleura of the upper and anterior portion of the chest through the subclavian artery. There also exists a collateral relation between the nutrient vessels of the lungs and the vessels covering the anterior portion of the neck through the inferior thyroid arteries. The collateral relationship existing between the vessels of the skin and of the lungs is still further extended by the connection of the bronchial veins with the azygos veins of the right side, and with the superior intercostal or the azygos veins of the left side. It is in the highest degree interesting to note these extensive communications between the pulmonary circulation and that of the cutaneous surface, all of which are of

high therapeutic interest.

"The kidneys are associated with the skin covering the loins through the renal branches of the lumbar arteries.

"The vessels of the prostate in man, the uterus and ovaries in women, and the bladder in both sexes, are associated with the cutaneous vessels overlying the sacrum, the buttocks, the perineum, the external genitals, the groins, the inner surface of the thighs, and the suprapubic region, these parts being chiefly supplied by branches of the internal iliac artery. These parts are also associated with the skin of the leg through the common iliac artery.

"The rectum is similarly associated with the skin covering the anal region and the perineum and that of the lower extremities.

"There is a collateral relationship, both venous and arterial, between the stomach, liver, spleen, intestines, and even the pancreas, and the skin of the trunk which overlies those deeply seated organs.

"The portal circulation communicates with the systemic circulation, thus establishing a collateral relationship with the cutaneous vessels at half a dozen or more points, especially the following: the hemorrhoidal plexus, the esophageal veins, the left renal vein, the phrenic vein at the surface of the liver, the epigastric veins at the umbilicus, the circumflex iliac vein (Treves, Schiff).

"In a similar way it may be stated that the upper half of the body is collaterally related with the lower half; a fact of which constant use is made when the lower extremities are warmed to divert blood from the head.

"The cutaneous vascular areas connected with the several viscera are roughly indicated in the accompanying diagram. It should be remembered, however, that every portion of the cutaneous surface is vascularly related, at least remotely, to every internal part. It is also interesting to note that the vas-

cular areas connected with the several internal viscera do not altogether correspond to the reflex cutaneous areas connected with the same parts, although in the main the reflex areas and the vascular areas are practically identical. For example, the skin covering the front of the chest is of greatest importance as a means of reflexly influencing the pulmonary circulation; whereas, the cutaneous vessels of the skin covering the back of the chest are more intimately related with the vessels of the lungs than are those of the anterior surface. A most important reflex relation exists between the skin covering the lower portion of the sternum and the kidneys, whereas the principal vascular relation exists between the kidneys and the skin covering the loins.

"The portion of the body below the umbilicus is collaterally related with the head, the arms and the upper half of the trunk; and the legs are likewise in collateral relation with all parts of the body above them, especially those which occupy the pelvic cavity."

I am obliged to confess that it is only within the last few years that I have appreciated the importance of utilizing photo-therapy as a means of producing local and general hyperemia of the skin for relief of the visceral congestion which is rarely absent in chronic disease. The pallor of the skin which is nearly always present in chronic invalids signifies not only anemia of the skin, but necessarily implies also congestion of the viscera. When the vessels of the skin are in a state of chronic spasm, especially when the skin is in that "hide-bound" condition which indicates deficient development of the subcutaneous tissue, there is necessarily a surplus of blood in the internal parts. The general muscular weakness which accompanies chronic disease prevents exercise so that the muscles as well as the skin are anemic. The importance of this fact will be recognized when it is considered



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that the muscles when active are capable of holding one-half of all the blood in the body. The idle muscle contains not more than one-fourth or one-sixth as much blood as the active muscle. A pale skin and inactive muscles necessarily imply congested viscera.

This chronic congestion of vital organs necessarily results in derangement of functions, and often in change of structure. Passive congestion or stagnation of the blood in a part necessarily involves diminished oxygenation and accumulation of CO_2 and other toxic substances in the tissues. The result is partial asphyxiation and autointoxication of the congested parts through the accumulation of tissue poisons. A congested liver can not do its duty as a bile-making and toxin-destroying viscus. The congested stomach first manufactures an excessive quantity of highly acid gastric juice, but with a deficiency of pepsin. Sooner or later even the acid glands are worn out and hypopepsia and apepsia result. The stomach then becomes a culture chamber for microbes of various sorts. Under the influence of the toxin produced, glands degenerate, resistance is lowered, chronic gastric catarrh develops, cancer and other neoplasms appear; through absorption of the toxins formed, the resisting power of the blood is lowered; general autointoxication occurs and various cachexias develop, skin diseases of various sorts and general and local nervous disorders appear, especially the various forms of neurasthenia. Even melancholia and paresis may be traced to the influence of toxins generated in the alimentary canal.

Similar results may follow congestion of the intestines. The resulting catarrh of the duodenum may extend into the liver and gall bladder, giving rise to jaundice, gall-stones, hepatic abscess, pancreatic disease, appendicitis, hemorrhoids, the various forms of colitis, mesenteric tuberculosis, tubercular peritoni-

tis, cancer of the intestines and peritoneum, and other maladies which are the outgrowth of lowered general and local vital resistance which may be properly traced to a blood supply which has deteriorated by long retention in over-dilated vessels. Abdominal dropsy and hepatic cirrhosis may be traced to the same cause. Pernicious anemia and possibly other forms of anemia are also due to this condition. Congestion of the sympathetic ganglia gives rise to abdominal pains of various sorts and a great variety of reflex pains and other symptoms, pain in the back, head, and limbs, paresthesias, neuralgias, and an almost infinite variety of mental and general nervous symptoms, vertigo, mental confusion, depression, pseudo-apoplexy, nervous irritability, nervous exhaustion, morbid fears and the *tout ensemble* of morbid phenomena presented by the vast proportion of neurasthenics and narcotics, both men and women.

The incandescent electric light bath which I introduced into therapeutics some fourteen years ago, I have found of inestimable value in dealing with all classes of chronic invalids. During the time which has elapsed since I first employed it, this bath has been used under my immediate supervision in more than forty thousand cases, aggregating several hundred thousand applications. At first I was inclined to attribute its chief value to its eliminative effects, but deeper study of the subject has convinced me that its chief value rests in its influence upon the circulation. Under the influence of the general electric light bath, the skin is filled with blood. The stimulation of the sweat glands is incidental. The perspiration has some value through its influence upon general metabolism, but the amount of toxic matters carried out through the skin is exceedingly small. The complete filling of the skin with blood removes the disabling congestion

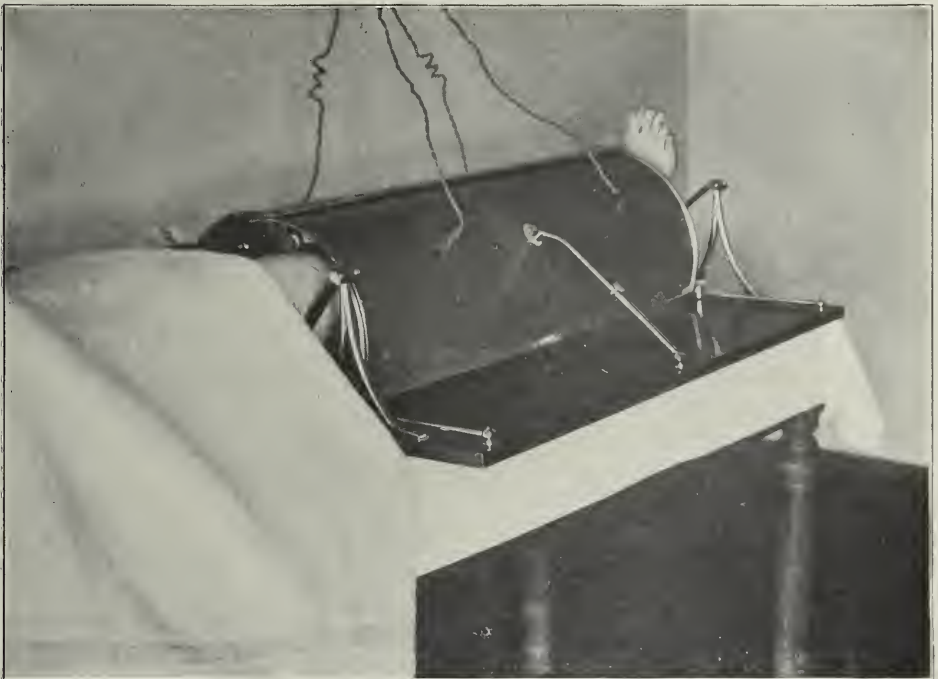
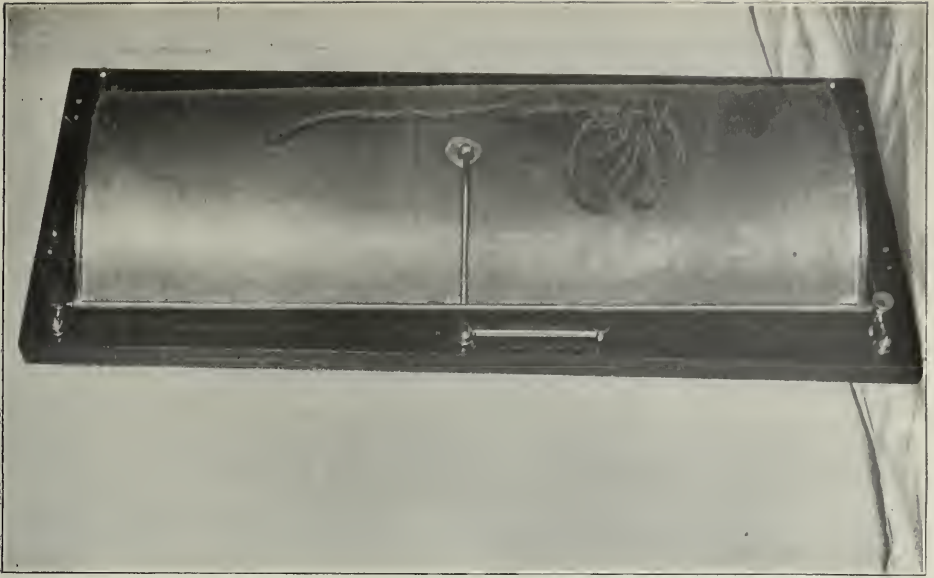
of the liver, stomach, spleen and other internal parts. This relief is rendered more or less permanent by the fixation of the blood in the skin effected by the cold application which always follows the electric light bath as well as other general heating measures. The vascular dilatation following this cold application is of much longer duration than that resulting from the application of heat alone; thus a more or less durable effect is produced. By a daily repetition of this procedure, normal conditions are gradually restored, the circulation of the skin becomes more and more active, the amount of blood in the over-distended internal organs is diminished, the enlarged liver and enlarged spleen contract, the congested sympathetic nerve centers return to the normal state, the vital resistance of the tissues is increased, catarrhs of the stomach and intestines and biliary passages disappear, the digestive secretions acquire their normal characteristics, the liver, adrenals, and lymphatic glands and other poison-destroying organs resume their functions; the various symptoms of autointoxication disappear; the skin reacquires its natural elasticity and color, and the patient gradually returns to a normal state.

These statements are not made on hypothetical grounds, but can be backed up by many thousands of clinical experiences, not only by myself, but by several scores of colleagues who have made use of this powerful therapeutic means at the Battle Creek Sanitarium, and in more than sixty allied institutions in different parts of the world.

For producing the effects above referred to long applications are not necessary. Three to six minutes are ordinarily sufficient. The duration of the bath need be only sufficient to produce moistening of the skin from perspiration. In certain classes of cases, longer baths are needed. This is especially true of obesity, rheumatism, gout, and

diabetics who are strong and not emaciated. In these cases it is necessary to continue the bath sufficiently long to produce an elevation of temperature, so as to stimulate oxidation of the proteid wastes. For this purpose the duration of the bath should be fifteen to thirty minutes, or until the temperature taken in the mouth reaches 100 to 100.5° F. It is better, when possible, to take the temperature per rectum.

Next to the incandescent electric light bath, the sun bath is most effective as a means of producing general hyperemia of the skin with collateral anemia of the internal viscera, and restoration of the normal balance of the circulation. I make use of the sun bath for this purpose at all seasons of the year, but find it especially valuable in the summer time, when I employ it by means of the outdoor gymnasium. The arc light bath may be used at all seasons of the year. A cabinet may be employed for this purpose with an arc light at each of the four corners, or the effects desired may be produced by successive applications to different parts of the surface until the whole body has been gone over. When it is desired to produce the more permanent effects which follow sunburn, I find it better to expose circumscribed areas of the skin on successive days rather than the whole surface at once, as the patient is thus saved considerable discomfort. A sunburn involving the whole surface may produce profound disturbance in an over-nervous patient. By repeated applications the skin becomes very vascular, and intense pigmentation is produced, as is well shown in the accompanying photographs. One of the subjects presented has just prepared to take his first light bath; the others have by daily exposure to the light become well tanned. In some instances I have seen the skin darkened to that extent that the individual might easily be mistaken for a mulatto or an Indian if only the color of the skin were



PHOTOTHERAPY IN CHRONIC DISEASES

regarded. The improved circulation of the skin which accompanies the pigmentation is always attended by relief from a multitude of disagreeable symptoms, and when these general light applications are supplemented by other indicated physiologic measures, proper regulation of diet and general habits of life, multitudes of cases incurable by other means are in the course of a few months restored to excellent health.

Local applications of light produce equally pronounced beneficial effects. Applications of the incandescent light may be made by means of the photophore, which consists of a metal cover enclosing one or more electric lamps. Lamps of any power desired may be employed. I ordinarily employ sixteen candle power lamps. Care must be taken to protect the edge of the photophore, if it is made of metal, so that the skin will not be burned. I have constructed photophores of various forms for application to different parts of the body. Some of the several forms which I employ are shown in the accompanying photograph.

I find these local applications of special value as a means of applying radiant heat to the spine, the abdomen, and the joints. This is a very much more effective means than any of the various forms of hot air apparatus which have recently been so extensively sold. A higher temperature can be borne because of the absence of moisture, and more exact results can be obtained, as it is not necessary to cover the skin, and there is no possibility of setting the patient's clothing on fire; and, if reasonable care is exercised, there is no danger of burning the patient. It is not necessary to confine the air in the apparatus, as the heat is not in the air, but is produced in the tissues, radiant energy being gradually converted into heat as it meets resistance in the opacity of the tissues of the skin and underlying parts. The part to which the application is

made may be made to tolerate an intense application for a long time by occasionally passing the hand over the heated surface. The pressure of the hand facilitates the change of blood in the parts, thus cooling the over-heated nerves while the penetrating rays of energy still continue their work.

I make great use of both the ordinary arc light and the arc light with iron, water-cooled electrodes for producing local hyperemia. By making the application long enough to sunburn the parts, the effect of a very hot fomentation may be produced, with the advantage that the beneficial effect lasts for days or weeks, instead of only a few hours. The duration of these local applications is from four to ten minutes, according to the patient's susceptibility and the effect desired. If the patient is blond and has a thin white skin, the minimum time is indicated. The accompanying photograph shows the pigmentation produced by the daily application of the photophore for a few weeks. The mottled appearance is characteristic. The pigmentation produced by the arc light is uniform in appearance.

Rikli believed that light is a food, supplying to the nervous system some subtle element which it requires. Neuens asserted that "light is the only source of life." Attention has been called to the fact that the inhabitants of hot climates are required to consume less nourishment because "they are nourished by light." It has been the purpose of this paper to show that some, at least, of the most remarkable of the therapeutic effects of light may be readily accounted for by principles which are well known to hydrotherapeutists, and without appealing to any theory of subtle, indefinable or hypothetical influence. I do not consider light as by any means a panacea, but when employed in the manner indicated in this paper, I am sure the results will not be found

disappointing. In fact, next to hydrotherapy, I know of no known therapeutic means which may be effectively

employed in so large a variety of chronic maladies as may be those which utilize the miracle-working energy of light.

RADIO-THERAPEUTIC NIHILISM *

BY GORDON G. BURDICK, M.D., OF CHICAGO, ILLINOIS

I AM in doubt about the intrinsic value of this paper, but I think it is time that some attention is called to the happy-go-lucky, go-as-you-please way of giving radio-therapeutic treatment.

Unquestionably some operators are getting good results, while it is equally true that other operators are having a sad time of it, and are in serious doubt as to the real value of the ray.

Some operators are independent of the surgeon, having very little use for his services, and as far as my observation goes, they are the most successful. Other operators seem to think that they exist simply to give radio-therapeutic treatment to cases that have been given up, or at least have had a very serious operation by some surgeon, condemning very loudly every other operator who dares to leave the surgeon out of his calculations. I do not desire to leave the impression that I have a mania against surgeons — far from it, as I am one myself — but what I want to impress upon the Society is the fact that the surgeon is of limited usefulness in malignant disease, and just as long as X-ray operators exist for no other purpose than to treat cases that surgeons have rejected as too extensive for an operation, their alleged experience should not be allowed to have any weight in determining the value of the X-ray in the

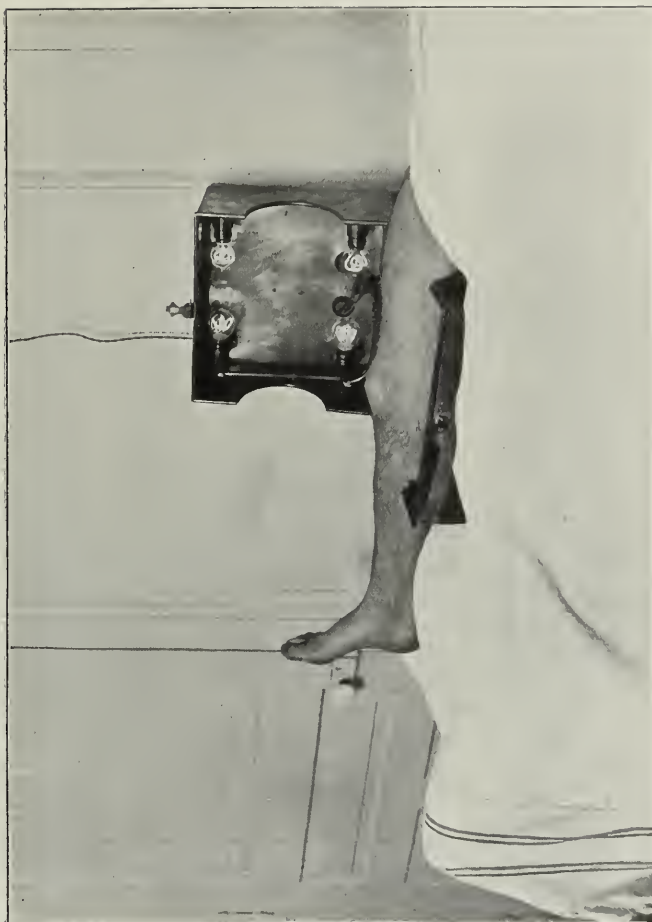
treatment of malignant disease.

Again, we find operators using all sorts of apparatus, from a two to a twenty-four plate static machine, and from a six to a thirty-inch coil; multitudes of interrupters giving all periods from about two hundred to fifteen thousand interruptions per minute; using tubes from various manufacturers, with glass varying in composition and thickness from 1/16 to 1/80 of an inch in thickness; and nearly every operator depending upon the fluorescent image on the screen to determine the strength of the ray, apparently not knowing that the fluorescent effect is due to the electromotive force, and that the E-M. F. is the same in a two or twenty-four plate static machine.

We must come to the old controversy of the low, medium and high tube again, some operators having good results with one kind and getting no results while using the other; all of these views must be considered to bring order out of chaos. I shall state my position rather emphatically, in order to make the issue clear-cut and allow the different members to discuss the matter upon well defined lines.

It is my opinion that the destructive effects noted in the various malignant conditions is due solely to the chemical ray, and in order to get the best results the degree of penetration should be controlled, in order to allow the ray to come at rest in the tissue where we want results. The more amperage sent through the tube the richer the radiation

**Read at the Fifth Annual Meeting of the American Roentgen Ray Society at St. Louis, Mo., September 9-12, 1904.*



PHOTOTHERAPY IN CHRONIC DISEASES

will be in chemical effects, and it should be the aim of each operator to use a ray as rich in chemical effects as is compatible with safety in tissue treatment. I believe, also, that the human tissue may become a transformer of a ray that is driven through the body at a high velocity, and that a motion actually takes place within the cells similar to but more rapid than we have when a current of electricity is sent through the body, and by these means we can account for the tonic effects noted in all cases that are rayed with hard tubes. The denser the tissue the more of the ray is transformed, which accounts for the fatty and colloidal degeneration noted in sarcoma: the motion is so rapid that disorganization of the sarcoma cell takes place, and it is replaced by a less dense tissue in order to accommodate itself to the rapid pace it is compelled to move at.

It is clear that anomalous results should be expected in this new science, considering the different types of apparatuses in use, but the principal difficulty is the X-ray tube. It has been thoroughly demonstrated that after a tube has been exhausted high enough to carry it to the line, that a sustained electro-motive force will give as much penetration as desired in ordinary radio-therapeutic treatment, and that the shape and position of the electrodes will determine the quality of the tube regardless of the degree of exhaustion after a given point has been reached; and that furthermore the parallel spark gap as a means of determining the degree of exhaustion is fallacious, inasmuch as I have constructed tubes with a twin anode and two cathodes which, with the same degree of exhaustion, gave a resistance upon one side of $\frac{3}{4}$ inch, and upon the other 9 inches, so that we have in the same tube both a soft and hard one without disturbing the vacuum in the slightest degree; so that the construction of tubes plays an important part in the variations of technic noted by different op-

erators, and accounts for the ever-recurring controversy of the soft and hard tube.

I have also found great variations in the thickness of the glass used to construct the various makes of tubes, and some of those broken and measured carefully have shown a variation of from $\frac{1}{8}$ to $\frac{1}{80}$ of an inch. When it is remembered the great amount of absorption glass is capable of, it cannot be wondered at that variations will take place, and severe burns result occasionally from a new tube. All skiagraphers know how difficult it has become to get tubes that are capable of making body pictures. It is also certain that a tube undergoes a change each time it is used.

It should be remembered that in an exhausted tube a shower of ionic metal accompanies the cathode stream, and forms chemical combinations when reflected from the target to the glass walls of the tube; and we are compelled to use aluminum for our cathode, as it is of the lowest atomic weight, and when pure leaves an invisible deposit; the thicker the layer becomes, the more of the energy of the ray is absorbed, and as all metallic substances transform the ray into waves of different lengths during its passage, it can readily be seen that tubes containing an aluminum alloy might make a tube with special idiosyncrasies that would have peculiar effects not obtained with a tube in an ordinary condition.

Many times in practice I have found a case that has resisted the ray stubbornly, and in sheer desperation I have passed the ray through a thin layer of some suitable metal, when suddenly the case took on a different character and began to get well. This phenomenon has been verified in bad cases by other operators who have asked me for advice.

There are many questions of the utmost importance connected with this subject that require the most careful investigation before a reliable technic can

be developed that is safe for unskilled operators to follow.

The issues that I wish to bring up for discussion are as follow:

First, technic for lupus and local tuberculosis. — Tube within four inches of the skin and the penetration regulated to within one-half an inch in order to take advantage of the ray of low velocity that resembles the cathode ray.

Second, for carcinoma and epithelioma. — Tube at ten inches, and the penetration calculated to about the center of the growth, producing irritation at least twice and then increasing the degree of penetration to a high velocity in

order to get a cellular degeneration.

Third. — Sarcoma requires a very high degree of penetration, depending upon the density of the growth.

Fourth. — Where a lethal effect on tissue is desired use a very low tube.

Fifth. — That the lethal effects are due to the chemical radiations.

Sixth. — That the tonic effects are due to the fluorescence of the ray, fluorescence being understood as a form of motion.

Seventh. — All unbroken carcinomata should be thoroughly rayed before operation.

GREETING

FOR the past thirty years there has been quietly but rapidly gaining ground in many quarters a belief that the various elements of physiological therapy should occupy a more prominent position in the management of disease than had hitherto been accorded them, but it was not until the discovery of the marvelous influence exercised upon malignant disease by the X-ray that the profession at large was brought to any adequate realization of the claims of these forces for therapeutical recognition. The incontrovertible curative and palliative results of X-ray applications was such as to command prompt and thorough investigation, and from radio-therapy to electro-therapy was but a short and logical step.

The richness of this latter field and the *modus operandi* of its potency led to the consideration of kindred methods of influencing physiological processes, and hydrotherapy, thermotherapy, the various mechanotherapies, etc., quickly attracted attention. Today thousands of physicians throughout the world are daily employing these agencies, studying their potentialities, developing their clinical possibilities, and reporting the experiences and conclusions resulting therefrom. The accrued literature, though scattered through various languages, has become enormous, and enough of it is valuable, reliable, and conclusive, to prove that physiological therapy has at

last attained an enduring place in our armamentarium.

The desirability of a special journal, which shall adequately cover these fields and constitute a medium through which shall be presented to its readers the work of investigators throughout the world, needs only to be mentioned to be appreciated when the therapeutical youth of these agencies is considered. Conceptions of their clinical utility and judgment as to their remedial powers are subject to constant and radical modifications at present, and determination of their limitations and potentialities can be facilitated in no better way than by bringing together, in a manner admitting of intelligent comparison, the results of different investigators. For this reason, in addition to the original articles in such a publication, an abstractive department, of a scope and comprehensiveness equal to that which constitutes a prominent feature of this periodical, becomes an invaluable, almost an indispensable asset to the progressive practitioner of medicine.

THE ARCHIVES OF PHYSIOLOGICAL THERAPY, then, makes its initial appearance at a time when there has developed a legitimate reason for its existence, and under auspices which we believe to be particularly favorable to the creditable accomplishment of its mission. This mission consists of the promulgation of knowledge relating to the therapeutical and diagnostic uses of the physical and psychical forces, whereby their actual and relative, absolute and adjunctive values may be determined, and their limitations defined.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION

It has been determined to hold the fifteenth annual meeting of this strong and rapidly growing association at the New-York Academy of Medicine, New York, on September 19, 20, and 21, 1905. Arrangements are being made to provide a large exhibit of electro- and radio-therapeutical armamentaria in addition to the regular programme of papers and discussions, and the meeting will undoubtedly be large and interesting. Forty-four new members were elected during the past year. Dr. Emil Heuel of No. 1 West Ninety-fourth Street, New York city, has been elected president for the year 1904-5.

CURRENT PHYSIOLOGICAL THERAPY

THE JOURNAL OF ADVANCED THERAPEUTICS

New York, N. Y., January, 1905.

1. Some Aspects of Phototherapy — Charles R. Dickson.
2. Remarks on High Frequency Currents and their Therapeutic Action — Walter H. White.
3. Clinical and Experimental Effects of Electrical Currents of High Potential and Frequency. — John H. Burch.
4. Radiography (to be continued). — Herman Grad.

1. Dickson emphasizes several factors concerning the use of light that other operators might heed with profit. He calls attention to the well known fact that the human skin is slightly yellow, and that the more pronounced this color is in an individual case the less penetration we can get with the ultra-violet ray. He has overcome the difficulty by using a solution of adrenalin chloride to bleach the skin; a procedure that has been used by several other operators with success. He favors the Fin- sen lamp as giving the greatest penetration, but condemns it because it is too expensive as regards initial cost, maintenance, the amount of room required, and the absolute impossibility of any American physician devoting one hour to each patient every day for months at a time, making it imperative that a nurse attend to the details of the treatment.

He favors the use of the iron electrode lamp called the ultra, which is operated by means of condenser discharges, taking in the current at three amperes and one hundred and ten volts, and stepping it up high enough to charge the condensers. The radiance from this lamp is claimed to be very rich in ultra-violet rays, and it exhibits

another advantage in that it requires no cooling device.

He also calls attention to the well known analgesic action of the ultra-violet ray and cites several cases to illustrate this action. Its tonic effect upon wounds and abrasions is very evident, granulations being markedly and immediately stimulated and a quick repair secured. In extensive angiomas it is useful as an application preparatory to the use of electrolysis, and acts kindly upon tissues that are in danger of breaking down from X radiation.

He has used it in the various types of eczema and with good success, but has had no better results in lupus erythematosus than other operators. His success in treating and aborting carbuncle has been little short of marvelous, and it is to be hoped that other operators will try the method in this terrible disease. A bad case of pemphigus yielded slowly to persistent raying, and a tonic effect was noted upon the body during the treatment. In sycosis he has had good results after failing with the X-ray.

He had the same experience as other operators in two cases, in having erysipelas follow X-ray treatment, and in the last case he tried the novel experiment of treating the disease by continuous raying, with, as he thinks, favorable results, inasmuch as the disease was of shorter duration. In the treatment of acne he combines vibratory stimulation with the light, and with good results.

The paper contains many good points and any operator will be paid by reading it.

2. See THE ARCHIVES, this issue.

3. Burch concludes from study of the literature upon high frequency currents that a profound ignorance of the nature of these currents is general, yet good clinical results are obtained from currents that are not properly high fre-

quency but only high voltage currents.

He believes with Freund that the essential in all these modalities is potential and that the greater the current that can be borne with these high tensions, the more pronounced the effect. A series of experiments upon photographic films was undertaken with a view to determining the actinic properties of the discharge from a resonator as compared with that from a static machine. Pieces of film in light, tight covers were sealed in Petri dishes, placed on a metal plate, connected with the lower spiral of an Oudin resonator actuated by an eight inch coil (4 amperes, at 30 volts), and from a brass point connected with the upper spiral sparks were directed for 30 seconds upon the upper cover. The film was very greatly fogged.

When such a dish was placed on a metal plate upon an insulated platform and connected to the negative side of a large static machine, having the positive pole-piece grounded and sparks from a grounded ball were allowed to fall upon the cover for 30 seconds, the film was not at all affected. Several variations of position and polarity gave negative results, but a Kinraide coil discharge reduced the film salts and so did the discharge from the resonator when actuated by the static machine.

Replacing the film by blotting paper saturated with potassium iodide, the iodine was liberated when the resonator and coil was employed, but not by the static sparks.

A test tube containing a bouillon culture of streptococci, having a wire passed through the cotton cork down to the culture media connected to the upper spiral of an Oudin resonator and suspended three inches from a plate connected to the lower spiral, was subjected to the discharge for five minutes and was then incubated along with a test inoculation which had not been so sparked.

The sparked tube remained sterile,

the control in 24 hours was swarming with streptococci. When the resonator was actuated by a static machine the colonies were fewer in the sparked tube than in the control; when the direct discharge from a static machine was employed both tubes grew about alike.

In comparing the histological effects of the modalities a rabbit was subjected to sparks from the upper terminal of an Oudin resonator actuated by a coil. The lower spiral was grounded, thus a recoil kick of five centimeters spark was obtained.

Another rabbit was subjected to the positive indirect static spark from a ten plate machine. Daily applications five minutes. At the end of third day the hair was roughened and at the eighth day it had fallen and a vesicular dermatitis was present in each rabbit, at the point of application. Microscopically there was present deep seated, small celled infiltration, extensive extravasation of blood and thickening and vacuolization of the intima of the arteries. During treatment the animals gained weight. The study of quiet discharges of high frequency and potential upon the human organism shows no histological evidence of any changes beneath the subcutaneous connective tissues. If change occurs it is functional or molecular. The effect on the sensory nervous system is *nil*.

A series of experiments upon man showed that direct applications from the resonator have little effect upon arterial tension, as have also stable applications with vacuum electrodes. Sparks from the resonator applied to the spine caused a rise of about 10 mm.

Auto condensation appeared to lower arterial tension.

From his series of experiments the author concludes that the physiological and therapeutical effect of these modalities is the result of potential almost entirely.

4. This article consists of the ad-

vanced sheets of the chapter on radiography and radiotherapy which will appear in "Conservative Gynecology," by Dr. G. Betton Massey of Philadelphia, to be published soon by the F. A. Davis Co. The accepted technique involved in making radiographs of the hand, elbow-joints, shoulder, chest, neck, abdomen, pelvis, hip joint, thigh, knee, ankle, and foot is described.

ARCHIVES OF THE ROENTGEN RAY

London, England, January, 1905.

1. The Dangers of the X-ray. — Milton Franklin.
2. Phototherapy. — J. W. King.
3. X-rays in the Treatment of Pruriginous Dermatoses. — J. Belot.
4. The Use of Hydro-Electric Methods in Medical Practice. — Sydney Whitaker.

1. In an interesting and instructive article Franklin rehearses the different pathological conditions producible by excessive application of X-rays and details the different theories that have been put forward as to the modus operandi of their production. His study of the subject leads him to believe that "The view advanced by Sir Oliver Lodge is the most acceptable of any, and accounts for the greatest number of observed phenomena. He believes that the action is directly due to the ionization or the oxidation of the tissues or the air at the point of impact of the rays. 'It is known that the X-rays and electric sparks can oxidize the nitrogen and ozonize the oxygen of the air.' It is not at all improbable that the action may depend on the amount of free oxygen present. I quote the following from Sir Oliver Lodge: '... The oxygen is wanted in some available and unstable form. Arterialized blood is

one substance which contains it in that form, especially under diminished pressure.'

"If we accept this view we have at once an explanation of the invariable action in the blood vessels and skin appendages of the action occurring on both sides of the body when but one has been exposed to the rays, and of the greater reaction observed at the points of entrance and of exit, observed by Scholtz, and mentioned above. This theory does not conflict with the observations concerning the combined action of the rays and the electrical discharges, and is altogether the most logical and acceptable theory that has been formulated. It might even account for the action of the rays on silver bromide in the presence of gelatine."

While individual idiosyncrasy toward action of the ray does exist, yet Franklin does not believe that it exists against the X-ray any more than against sunlight or any other therapeutic agent. Weak or emaciated persons or those suffering from some disease, however, may be more likely to respond unhappily than those who are well.

The dangers under X-ray exposure are very present and in many cases pregnant with irreparable consequences, and with our present knowledge of the character and behavior of X-radiance there is little excuse for injury of patient or operator. Franklin has invented a method of measuring the energy of the radiations from a Crooks' tube, which consists in measuring the ionization of the atmosphere by means of an electroscope of special design. In addition to the accepted measures for preventing X-ray burns he adopts the following:

"Every patient, no matter what the location of the lesion, is placed recumbent upon the operating table and protected with sheets of lead-foil. For each patient is employed a separate mask, having an aperture which permits only the lesion to be exposed. This in-

asures against appreciable movement on the part of the patient or injury from unavoidable slight movement.

"The exposures are made of a definite potency in accordance with my method of radiometry. This potency is small in the beginning, and gradually increased to the point desired. Accurate data with regard to these measurements will be published in connection with the system.

"For the operator, I can only say, in addition to what is already known concerning precautionary measures, that the added aggravation of developing solutions ought to be obviated by the use of rubber gloves.

"In conclusion, the physiological effects of the X-rays are now so reasonably certain that in the hands of competent operators untoward effects are scarcely to be expected."

2. King reports several cases which he treated by the electric arc light, the X-ray, and the Piffard ultra-violet lamp. One case of well-marked tuberculosis of the left lung recovered entirely under the arc light treatment in combination with anti-tubercular remedies. In a case of locomotor ataxia the X-ray seemed to quiet the irritation in the cord, but King is inclined to attribute the cure of the case to mechanical vibratory stimulation which was applied to the spinal nerve roots synchronously with the X-ray treatment. Patient has remained well for nine months.

He has not observed much influence from the Minin light except in the treatment of tic douloureux wherein he thinks it acts as a specific.

The Piffard lamp is very highly spoken of in cases of lupus erythematosus, rodent ulcer, etc., some of which responded to this after the X-ray had failed. An obstinate X-ray ulcer also healed in two weeks after treatment was begun with the Piffard lamp. He has used it successfully in cases of acne wherein the X-ray had not been efficient.

King has not been able personally to verify the claims that have been made for the high frequency currents in the treatment of malignant growths, but considers that the difference may be due to a difference in technique. He has also found that one kind of radiation will cure in one case and a different kind in another. For instance:

"An old lady suffering from cancer at the inner canthus of the left eye did not show any improvement under the ultra-violet ray but she was readily cured by the X-ray. On another occasion the X-ray utterly failed and the ulcer promptly cicatrized under the ultra-violet ray. These patients were seemingly alike in every respect."

3. X-rays are efficacious in the treatment of itching without gross skin lesions and also when the itching is accompanied by skin lesions. Belot uses tubes giving rays of a low degree of penetration and tries to avoid dermatitis. He employs rays corresponding to three or four of Benoist's radiochromometer, and causes to be absorbed at each seance a quantity equal to three or four units according to Holtzkecht's scale. The disease can easily be controlled inside of ten or twelve days. It sometimes recurs after a couple of months, when the treatment should be applied again. The different varieties of affections in which itching constitutes a prominent part are discussed with reference to treatment by X-rays at some length. Belot thinks very favorably of their future usefulness in these conditions.

4. Whitaker describes minutely the technique involved in administration of the hydro-electric enema. Large clay electrodes are placed upon the back and abdomen of the patient, and about two quarts of water are passed into the colon. Syringe is so arranged that the water in the colon is made one pole and the current flows between this water and the two electrodes on the surface of the body. The current strength usually is

from ten to twenty ma. and the seance duration fifteen minutes. Drugs, as nitrate of silver, etc., may be passed into the wall of the colon by phoresis in this way.

Two cases, one of mucous colitis of long standing, the other of fermentation of food in the stomach and intestines with attacks of colic and painful distention of the colon, were much benefited by the use of the douche applied as described above.

ARCHIVES D'ELECTRICITE MEDICALE

Bordeaux, France, December 10, 1904.

1. A Case of Simultaneous Radio-dermatitis in Operator and Patient. — D. H. Guilleminot.
2. The Utility of Plate Boxes as Plate Holders in Radiography. — D. M. Gagnere.
3. The Present Status of Radiotherapy. — Prof. Jaime R. Costa.
4. The Present Status of Medical Electricity in England. — D. Bonnefoy.

1. Guilleminot had been in the habit of locating needles in the palm by fluoroscopic examination, making his incision by daylight and then in a darkened room, removing the needle by forceps guided by the image on the screen. For this purpose he employed a rest for the hand, a special tube holder, and a small screen two inches in diameter attached to a projecting bracket from a headband. The forceps were guided by the image on the screen until the foreign body was felt and grasped.

In the case described he worked unsuccessfully for half an hour, holding the patient's hand in his own left hand at a distance of about ten centimeters from the tube. Owing to the situation of the needle he was unable to use the regular support for the patient's hand.

Four days later a second attempt lasted three-quarters of an hour. Altogether he estimates that the patient's hand and his own were exposed for thirty-five minutes at an average distance of ten or twelve centimeters, the tube being soft and giving rays of about No. 5 of Benoist's scale.

After four days burning sensation obtained on left middle finger; after six days burning sensation on right index, middle, ring fingers. Thus far no signs of trouble obtained on patient's part. Eight days after the second exposure the patient started in to have a regular X-ray dermatitis of the back of the hand, followed by sloughing and ulceration, which healed in six or eight months, but the skin was not entirely sound for a whole year. Even long afterward the skin was tender and had to be protected from mechanical and thermal injury.

The doctor's own hand went through the process of ulceration and loss of three finger nails and was practically healed in six weeks, except the last joint of the left middle finger. It was noted after complete healing that the patient's hand showed some unnaturally heavy hairs at a little distance from the parts most affected. He concludes that a moderate dosage of X-ray stimulates the papillæ and an excessive dosage destroys them.

2. Gagnere does not favor the ordinary black envelopes as plate coverings because if the plates are put in them by the manufacturer so long a time elapses before they are used that the plate becomes fogged by emanations from the paper; if they are loaded by a laboratory assistant the film surface is liable to be scratched or marred by finger prints, either of which will deface the affected part of the plate. He uses the pasteboard box in which the plates are bought, pasting little pieces of cardboard about two millimeters thick in each corner of the bottom of the box, placing the plate film side down, resting

upon these, then a board of the right size and thickness to fill the box and then the box cover. In use the box is turned over so that the film side of the plate is toward the X-ray and is covered by only one thickness of pasteboard. When not in use the film is separated from the pasteboard and therefore undergoes no chemical change and is amply protected from light.

3. Costa says that radiotherapy has, among other things, cleared the horizon as regards the treatment of some parasitic diseases of the skin and many neoplasias. Generally speaking he recommends long intermissions, short applications at intervals, and eternal watchfulness of the part under treatment in order to foresee and prevent the severe reaction which the cumulative action of the X-ray makes it impossible to arrest when once inaugurated.

He reports good results in hypertrichosis, two cases with regular beards being mentioned. Treatment should be applied every other day for a couple of weeks, producing preferably an erythema and loss of hair. The hair returns in two or three months, but less plentifully and is exposed to a second, third, or even fourth series of applications if it returns persistently. In each of the cases mentioned there was an X-ray burn of the second degree, which could have been avoided by more patience. In the case of a light fuzz he recommends palliative measures like decolorizing by peroxide of hydrogen in preference to X-ray treatment.

For sycosis X-ray depilation and destruction of the germ constitutes the best known treatment. In his cases hair returned in about two or three months except in one case where severe radiodermatitis was produced, and there followed absence of hair and an atrophic condition of the skin for several months.

Costa has had good results in alopecia areata, treatment being severe enough to cause depilation of the im-

mediately surrounding hairy scalp. Growth of hair took place on the center of the patch of alopecia sooner than in the areas denuded by the X-ray. The same treatment is recommended for acne, acne seborrhœa, and possibly hyperidrosis. Cases of keloid have been reported cured in North America and Germany. He has seen a case of rhinoscleroma noticeably modified by X-ray treatment, also tubercular leprosy. He has not had good results in lupus erythematosus; says that treatment must be mild because in these cases the X-ray may excite an excessive reaction. In tubercular lupus, however, the results are good; he has had only one case and a cure resulted in that. In tubercular ulceration of the skin and tubercular adenitis he alludes to cures reported by Pusey.

As regards epithelioma, he quotes statistics gathered by Skinner of Connecticut, showing 95 per cent. of cures. Costa's own cases number 25 or 30, and the results give him the firmer belief in the efficiency of X-ray treatment. The resulting cicatrix is a great deal better than after excision or cauterization; pain is relieved at once by an influence on nerve tissue. A cure is effected in from five or six to fifty or sixty applications with a soft tube, 2 or 3 centimeters parallel spark, but for deeper infiltrations or for nodules an 8 or 10 centimeter spark equivalent is best. Warty excrescences loosen at their edges and should be removed in a few days, leaving an ulcer which heals rapidly. If these do not come away readily he cauterizes them with the high frequency spark.

In his early cases he produced an X-ray dermatitis, an ulceration which healed much more slowly than the epitheliomatous ulcer would have done. The X-ray ulcer is characterized especially by its painful character, and in some cases requires excision and skin grafting. On other occasions the treatment

has given rise to attacks of eczema. These conditions may be prevented by caution.

Epithelioma of the lip, tongue, and inside of the cheek is a very different matter, although of similar microscopic appearance, and the cases in which cachexia and glandular involvement appear early seem to be little influenced by the X-ray. He reports, however, a case of epithelioma of the velum palati and the pillars of the fauces, in which the middle portion cicatrized and the patient became able to swallow solids after X-radiation. This was a case of several months slow development without glandular involvement. Not having any special apparatus like Caldwell's X-ray tube for introduction into cavities, he made use of a speculum like Ferguson's.

In cancer of the breast he has seen some excellent results as well as some with lack of result. One case with glandular involvement in the axilla resulted in the breast becoming simply a fibrous nodule, smaller than the sound one.

He determines the degree of vacuum in a tube by measuring the parallel spark; generally speaking a soft tube is one of about 4 centimeters resistance and a hard tube backs up a spark of 10 or 12 centimeters. Benoist's radiochromometer determines the degree of vacuum fluoroscopically by contrasting the shadow of a silver disk, with the shadow of a certain thickness of aluminum on a graduated scale; No. 5 corresponds to a low vacuum and No. 7 or 8 to a high. Holznecht's chromoradiometer, by which the number of units of X-radiance applied is measured by the color change taking place in a test object during the exposure, is subject to wide variation in reading.

Bergonie and Oudin in France, Williams and Pusey in North America, and Schiff and Freund in Austria advise short applications at frequent intervals until a reaction is produced, while Kien-

böck and Holznecht in Austria and France prefer strong applications, followed by a long interval of rest. Costa himself adopts an intermediate course, soft tubes for the skin and hard tubes for the stomach, breast, etc., tube 10 centimeters distant from the skin in all cases; 12 inch coil, 4 or 5 amperes and 40 to 60 volts actuating primary, 1,200 interruptions a minute, protection of adjacent parts by sheet lead $\frac{1}{2}$ millimeter thick.

In very delicate cases, such as hypertrichosis he makes one experimental application of five minutes duration and then waits fifteen days. In other cases five-minute applications are made every other day from the beginning. Four applications produce a minimum reaction (depilation with light erythema), and small epitheliomata are cured in five or six. In other cases he continues up to 8 or 10 applications and then he invariably waits for twenty days or more. When all trace of the reaction has disappeared, he gives a series of six or eight applications, then a long interval, gradually reducing the number of treatments in each series.

A few days, generally six or eight, after beginning treatment there is a little pigmentation, and at the end of twelve days this area becomes reddened and the hair falls. The reaction should not extend beyond this stage. If the treatment has accidentally been too strong vesicles form, the epidermis exfoliates, and cicatrization takes place very slowly, leaving the skin smooth, pale, and atrophic, surrounded by a pigmented zone. Very much too severe treatment produces ulcers, which are very painful and which take months to heal.

He treats mild erythema with borated vasoline, simple cerate, astringent lotions, or drying powders with oxide of zinc as a basis. Severe dermatitis is treated with oxide of zinc ointment, ichthyol, and lanolin, or orthoform; if the pain is severe, administering anti-

pyrine, aspirin, or morphine internally. Deep ulcers require wet antiseptic dressings, preferably of peroxide of hydrogen one part to three.

4. Bonnefoy gives a very complete description of the electro- and radio-therapeutic equipment of the different hospitals of England and Scotland.

ARCHIVES D'ELECTRICITE MEDICALE

Bordeaux, France, December 25, 1904.

1. Apparently Toxæmic Symptoms in Three Patients under Radiotherapy for Cancer of the Breast. — Dr. Haret.
2. A Means of Rendering the Rays from Roentgen Tubes Identical. — A. D'Arsonval.
3. Dr. Levy-Doin's New Orthodiagraph. — Dr. Bergonie.

1. Among the cases treated by the X-ray in Dr. Beclere's laboratory apparently toxæmic symptoms have been noted in three. All were women with non-ulcerated cancer of the breast.

Case I. — Woman, 60 years old, two operations, one three years and one two years before beginning X-ray treatment. There was a hard nodule the size of an almond in the cicatrix, and the chest wall was strewn with minute cutaneous nodules. At each treatment, twice a week, 4 H. (Holznecht units) were applied to the region of the tumor, followed by 4 H. to the region of the cutaneous nodules. After the fourth treatment the cutaneous nodules had disappeared, but the patient complained of symptoms which had not been present before treatment, viz., vertigo, palpitation, absolute anorexia, insomnia, and at one time a rise of temperature. Treatment was continued, but these symptoms increased to such an extent in another week, that the patient was too weak to come for treatment. The

symptoms all disappeared and ten days later treatment was resumed, but on account of a slight reaction in the skin the subsequent applications were milder. There was no return of the symptoms, the cutaneous nodules disappeared, the tumor diminished markedly in size, was no longer painful, and four months later the patient was still in this favorable condition.

Case II. — Woman, 50 years old, whose sister had been operated on for a tumor of the breast; on self examination she discovered an indurated nodule the size of a cherry near the nipple, and a small axillary gland. No pain or general symptoms. Not wishing, in so mild a case, to excite any reaction at all a minimum dose of the X-ray was given the first week, the second week 4 H. over the tumor and 4 H. over the axillary glands. The following applications were of 3 H. over the tumor and 3 H. over the axilla. In all five treatments 17 H. were given over each area. The patient then stopped the treatment because of violent headache, palpitation, insomnia, and extreme weakness. After an interval of fifteen days the tumor was found to be smaller, the axillary gland to have disappeared, and her general condition to have become good again. The patient was persuaded to have one more treatment of 4 H., which was followed by a return of the symptoms and a refusal on the part of the patient to have the X-ray applied any more.

Case III. — Aged 61. Had been treated with the X-ray at Carcassone, but returned to Paris for personal reasons and asked to have the X-ray treatment continued. Operated upon two years previously, and after eighteen months discovered a recurrence about 30 millimeters transversely, 26 vertically, and 20 in thickness; nothing in the axilla. These measurements were made by the surgeon who had previously operated and who now commenced X-ray treatment. This was six months before

she came to Dr. Haret, who found the skin somewhat reddened in consequence of the treatment. After an interval of eight days weekly applications of 4 H. were begun, reduced after the first two weeks to 3 H., as the skin was a little red. After four treatments the tumor was smaller. After five treatments 14 H. over each region, she complained of violent malaise, lassitude, vertigo, feeling of suffocation, headache, and anorexia. The patient declared that electricity disagreed with her, as she had had the same symptoms at Carcassone. Nevertheless the treatment was continued, but with greatly reduced dosage. The disagreeable sensations disappeared and the tumor continued to diminish.

Haret does not think these symptoms developed as a natural consequence of the disease; the occurrence and disappearance of the symptoms were too closely connected with the treatment for that. Neither were they due simply to the influence of the X-ray upon the system, for it was not seen in the numerous other cases treated. Nor to the spread of cancer cells by the X-ray, for there is no reason to think that this occurs or that the X-ray ever causes metastasis. In cases of cancer of the breast, mediastinal adenopathy may often be demonstrated by the fluoroscope, even when there are no physical signs, and in such cases the patient is going to die of mediastinal cancer whether the tumor of the breast is treated with the X-ray or is subjected to the best surgical operation. The symptoms were due to the absorption of a sort of toxine which would escape as an increased discharge if there were an ulcerated surface. Williams is quoted as thinking it desirable even to create an X-ray ulceration as an emuncatory. Haret, however, thinks an incision would be preferable, but says that all that is necessary is to diminish the dosage when such symptoms occur.

2. D'Arsonval gives four series of radiographs of Benoist's radio-chromom-

eter (a disk of silver surrounded by sections of aluminum of different thicknesses; the thickness of aluminum which casts a shadow equal to that of the silver disk, furnishing an index of the penetration of the X-ray).

In the first series all the pictures were made with the same tube, but with quite different degrees of vacuum. The secondary current passing through the tube was adjusted so as to be the same in each case (measured by Gaiffe's milliamperemeter directly in circuit with the tube), and the time of exposure was the same. All the pictures show the same degree of penetration and are exactly alike.

The second series was made with the same tube and the same degree of vacuum, but with different strengths of current and with the time of exposure so arranged that the product of the intensity (in milliamperes), and the time (in seconds), was equal in all three cases. All the pictures in this series proved identical.

The third and fourth series were made with tubes of different sorts and sizes, the same number of milliamperes being sent through each and the time of exposure being the same. The pictures all turned out the same.

His conclusions are that with the same current the quantity and quality of the X-ray is the same, even if the degree of vacuum is different.

That the tube can always be made to give out the same ray and that this may be kept up as long as necessary.

That the rays may be changed by changing the current without making any change in the degree of vacuum.

That with a given degree of vacuum the quantity of ray is proportional to the strength of the current through the tube.

That by the employment of a milliamperemeter one can always secure the same effect from a tube.

He attaches importance to the statement that the quality of a tube is suffi-

ciently determined by measuring the mean strength of the current which passes through it and its degree of penetration; that any radiographer can repeat with absolute certainty any experiment with these specifications given.

3. Levy-Doin's orthodiagraph is adapted either for the vertical or recumbent posture of the patient. Horizontal motion of the tube and screen is accomplished by the motion of a carrier between two parallel rails, while vertical motion is indicated on a scale and the exact dimensions of the heart, etc., may be determined without the use of the crayon at all. The picture may be drawn upon paper or upon the patient's body, and of course represents the natural size of the organs.

BULLETIN OFFICIEL DE LA SOCIÉTÉ FRANÇAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE

Paris, France, Nov. and Dec., 1904.

1. Continuation of Discussion on Radiotherapy.

Radiotherapy in the Treatment of Spleno-Medullary Leucæmia. — Prof. C. Colombo, Rome.

On the Use of Shields Surrounding the X-ray Tube. — Oudin, Billinkin, and Desplats.

2. The Condition of the Muscles in the Neighborhood of Scapulo-Humeral Periarthritis. — D. Rene Desplats of Lille.

3. Biologic and Therapeutic Actions of Variable Magnetic Fields. — Dr. Colombo.

1. In treating three cases of spleno-medullary leucæmia Colombo used the following technic: Patient recumbent, tube 20 cm. from the skin vertically above the part treated, primary current 105 volts, 3 to 3½ amperes, current through the tube 1½ to 2 ma. (Gaiffe). Tube of medium vacuum resistance 5.8

cm. Penetration 8 or 10 (Benoist's radiochromometer), daily applications of 40 minutes (10 minutes over spleen, 10 over elbows, 10 over knees, 10 over sternum), each region receiving about 1 Holznecht unit. This he considers a safe method, not causing a cutaneous reaction which would cause a large amount of the retrograde products to enter the circulation.

In one case there was no result from 25 treatments. In another 60 treatments produced a satisfactory result, both as to reduction in the size of the spleen and the number of leucocytes. In the third case, after 25 treatments, the red cells had diminished from 2,780,000 to 2,500,000, and the leucocytes had enormously increased from 96,000 to 440,000. The spleen remained of the same size and the fever was unchanged.

Oudin says that the presence of an opaque box around an X-ray tube to shield the operator and all parts of the patient, except the parts to be treated, results in rapid hardening of the tube. In the dark an emanation from the wall of the tube may be seen by the skilled observer, this being due to the formation of a secondary anticathode and leading to a deposit of platinum on the wall of the tube. Grounding the shield prevents this, especially if the positive pole can also be grounded. This would be likely to burn out a coil, but is practicable when a transformer is used to apply the current to the coil.

Billinkin says that a layer of mica inside the shield would prevent the trouble. Ebonite would not, as it is nearly always impure.

Desplats says that the phenomenon occurs only with hard tubes.

Oudin answered that mica or ebonite do not remedy the matter any more than does the air space between the tube and the shield. It is worse with a hard tube, but present with a tube of only one centimeter spark equivalent.

2. Desplats refers to a report by Zim-

mer of successful treatment of ankylosis of the shoulder with electricity, and reports in detail four cases of his own.

Case I. — Man, 26 years old. Pain beginning gradually without traumatism. Three days later gave up work, as he was unable to lift his arm. Treated for rheumatic arthritis of the shoulder joint without any relief (internally and by topical applications).

After two months and a half his condition was as follows: Considerable atrophy of the right shoulder and of the muscles of the right arm, absolutely impossible to move the arm more than eight inches from the body, defensive contracture of the pectoralis major, crepitus on passive motion, forced abduction very painful. Diminished faradic or galvanic contractility of all the atrophic muscles. Treatment three times a week, galvanism, positive large electrode behind the shoulder, negative electrode 7 x 10 cm., embracing the head of the humerus, ten minutes, 55 to 60 milliamperes.

After five treatments the joint seemed all right, and he could move the arm. Treatment was changed to faradization of the atrophied muscles, but a few days later there was a return of the disability and galvanic treatment was begun again. One month from the first treatment the patient was discharged cured. He was seen three months later and was still well.

Case II. Man 54 years old, pain without traumatism began two and a half months previously. When treatment was begun there was partial ankylosis, no pain except on motion, contracture of pectoralis major, atrophy of the shoulder and arm, diminished power in the biceps, diminished faradic and galvanic contractility, but without qualitative modifications.

Treatment same as Case I, but with 100 milliamperes. After three or four weeks it seemed as if the pectoral contracture was not yielding well enough

and a sponge electrode was applied over that. The application, though painful, resulted in benefit, and was repeated several times. The patient was still under treatment and was almost well at the time of this report.

Case III. Woman, 25 years old, anæmic, had had three children. Sixteen days after the last was born, pain in elbow, and especially in left shoulder was observed, accompanied by fever and slight gastric disturbance; could not move the arm and had to stay in bed. Admitted to the hospital a few days later and put on salicylate of sodium internally and salicylated applications locally. Pain relieved but could not move arm. No redness, no deformity, no crepitus, active and passive motion impossible, but it was difficult to say how much was due to ankylosis and how much to contracture of the pectoralis. Electrical treatment was begun twelve days after the commencement of the attack; 40 milliamperes, negative electrode over articulation daily for a couple of weeks and afterwards every two days. At the end of six weeks all motions could be made easily and there was only a little muscular weakness which time would remove, and patient went back to her customary avocation.

Case IV. — Man. Six years previously had severe tubercular peritonitis and was in the hospital for six months. Got well and remained well until present attack, which was diagnosed as rheumatic peri-arthritis and treated by the usual methods for twenty-one days, with relief of pain, but there remained complete loss of function. Cries out if an attempt is made to move the arm from the side, marked flattening of the shoulder, atrophy of the deltoid and a wooden hardness of its anterior border. Moderate atrophy of the arm muscles, complete loss of electric contractility in the deltoid.

Galvanism was applied, 120 milliamperes for 20 minutes, three times a week. At the eleventh treatment the joint mo-

bility seemed perfect, but active motion was still difficult on account of muscular weakness. On this account and because the skin had become irritated the change was made to galvano-faradization of the muscles with the sponge electrode. This was continued for a month, at the end of which time the patient seemed entirely well except for a certain induration of the deltoid.

He thinks most cases of disability about the shoulder are not traumatic, but are from a periarthrititis. These patients generally apply for treatment several months after the beginning of their trouble, the pain having disappeared, but the disability remaining, although a certain amount of motion is possible with a severe effort, diminished muscular power and atrophy of the shoulder and upper arm, and diminution or even loss of electrical contractility. The cases are susceptible of cure by properly applied electrical treatment.

wound secretions which is of great importance. A dry dressing generally seals up the wound, the first discharge coagulating upon it and preventing further absorption. A wet dressing with oil silk over it retains the germs in the dressing and no amount of antiseptic which the tissues will stand will have any great effect on the germs. It really forms a great big mass of corruption from which the wound is more or less poisoned.

From experiments on wounded animal and bouillon cultures he concludes that a moderately moist dressing of gauze, somewhat crumpled with absorbent cotton, and a loose bandage outside is the ideal one. By osmosis it establishes a current away from the wound and removes the germs. The dressing may be moistened with plain water or normal saline solution and if it sticks to the wound peroxide of hydrogen loosens it immediately.

Absorption and evaporation form the basis of the treatment of wounds which may be infected. In any case thorough mechanical cleansing precedes the dressing and if a wound is surely not infected it may be sutured or sealed by a septic varnish (steresol or adhesal), which he prefers to collodion.

2. Levy considers that the essential part of the treatment of neurasthenia consists in the education, the re-education of the patient; isolation, rest, super-alimentation are valuable adjuncts, as are electricity, massage, and different medicines. If there is muscular weakness, of course rest and gradually increasing exercise are indicated, but the indiscriminate or routine prescribing of long periods of complete rest for each case, where the patient is weak, largely because he thinks he is, may fail entirely. He cites two or three such cases which have subsequently yielded to a few days' education of the patient's will, accompanied by exercise. In cases in which the rest cure is used at all it should usually

JOURNAL DE PHYSIOTHERAPIE

Paris, France, December, 1904.

1. The Physical Effect of the Dressings upon Infected Wounds. — Dr. A. Gottschalk.
2. Dangers of Prolonged Rest in the Treatment of Neurasthenia. — Dr. P. Emile Levy.

1. Gottschalk thinks that antiseptics have very little effect in preventing infection in wounds. That the tissues have a means of defense against germs and poisons and that the study of these means of defense forms the basis of rational therapy. The first thing that nature produces in cases of a wound is hemorrhage, followed by serous or sero-sanguinolent discharge, all of which act mechanically to remove germs. Then there is phagocytosis, which he does not insist on and a bactericidal action of the

be considered as a period of waiting and recuperation preceding the really curative active treatment.

FORTSCHRITTE AUF DEM GEBIETE
DER ROENTGENSTRAHLEN, VOL.
VIII, NO. 2.

1. The Chronic Roentgndermatitis of the Radiologist. — Dr. P. G. Unna.
2. The Indications for Treatment with the Roentgen Rays in Dermatology. — Dr. W. Scholtz (Koenigsberg).
3. Contribution to the Histology of the Roentgen Action upon the Normal Human Skin. — Dr. P. Linser.
4. The Symmetry of the Roentgen Reaction. — Dr. G. Holzknecht.
5. The Roentgen Radiation of the Testicle of Man. — Dr. Philipp.
6. A Contribution to Radiotherapy. — Dr. R. Hahn, Hamburg.
7. Transportable Illumination Box. — Dr. R. Stegmann.
8. A New Orthodiagraphic System of Notation. — Dr. Max Levy-Dorn (Berlin).

1. This is a most complete investigation of the Roentgen dermatitis of the radiologist, based upon a study of ten cases by the author. This article is quite lengthy, and no abstract can do it justice. It is of the greatest importance, and therefore, if possible, it should be read in its original form by every radiologist.

In one case this dermatitis was found to develop in several months, in another in nine months, a third in a year, the fourth and fifth in three years, and the sixth in seven years. It therefore is a slowly developing dermatitis.

The back of the hands and particularly the second and third fingers are most affected. In other words the parts

that received most of the direct rays were most affected.

This dermatitis is directly due to the action of the X-ray, but it is aggravated by the action of developers and disinfectants. In addition to the above causes the individual factor plays an important part.

Most of the symptoms are familiar to the radiologists, but there is considerable variability in degree of particular symptoms. The most common are the redness, swelling, fissures, thickening of the skin, atrophy, soreness, loss of the lanugo hair, and both longitudinal and oblique fissures of the nails. These symptoms are aggravated by exposure to the rays, by disinfectants, by exposure to cold, by cold water, and by the developers and fixing bath. They are also often made worse by medicaments applied for curative purposes.

Histological studies show that all of the elements of the skin are affected. The injury to the blood vessels which seem to be most affected in acute dermatitis, and which seems to be the direct cause of the ulcers, in this form of dermatitis seem to be least affected. The most notable change in the blood vessels is the dilatation of the capillaries. The upper layer of skin is much thickened, and hardened. At places it is hypertrophied and predisposed to cancer, at other places it has undergone atrophy. There is an atrophy of the epithelium, the oil and sweat glands, and the hair and nails. In the true skin there is a chronic interstitial œdema, which leads to an atrophy of the elastic tissue. At the base of some of the slowly healing fissures, cancer cells were observed.

The greatest good can be expected from prophylaxis. This should consist in avoidance of exposure to the rays either by opaque gloves, by bandages with lead plaster, or entire cessation of the work. Even the stray rays should be avoided. To this should be added the avoidance of the injurious effect of

the developers, fixing baths, and disinfectants.

In treatment the author advises that the hands be bathed from one-quarter to three-quarters of an hour in warm water with superfatted soaps, and then the application of one of the following ointments:

Ung. Hebrae rec. par.,	25.0
Sol. calcii chlorati,	10.0
Glycerini,	5.0
Adipis lanae,	10.0

or

Ung. Hebrae rec. par.,	35.0
Acidi salicylici,	2.5
Sap. kalini,	2.5
Vaselini,	10.0

2. The diseases in which the Roentgen rays are indicated may be divided into four groups.

The first group includes the new formations of the skin in which the rays have a degenerative effect upon the new growths. This includes the carcinomata, and sarcomata of the skin which are inoperable because of their location, their extent of involvement, or the refusal of operation by the patient. The application of the rays is especially advised after operations at intervals for two years. This group includes also lupus vulgaris, lupus erythematosus, mycosis fungoides, verucæ, and angiomata.

The second group includes the affections involving the hair, as hypertrichosis, favus, sycosis, and acne. The rays are only advised in the obstinate cases in which the ordinary methods have failed. The rays are not indicated in the treatment of hypertrichosis, because it must be removed several times, which occupies a period of about two years, and in the end does not give very good cosmetic results, because of the atrophy and wrinkled condition of the skin.

The Roentgen treatment is also hardly advisable in alopecia areata.

In the third group are included eczema, lichen chronicus, and lichen ruber planus.

The fourth group includes the itching affections, pruritis, prurigo, and neuralgia of the skin. The Roentgen treatment is only indicated in those cases which resist the ordinary forms of treatment.

3. Linser finds no noticeable changes in the epithelium. The hair and skin glands are also free from change. The connective tissue and nerves seem to be free from degenerative changes.

Only the blood vessels showed changes. Four days after exposure thromboses were found in several of the vessels. The whole lumen was filled with leucocytes. The epithelium was missing at some places, and at others it was swollen and bulged into the lumen. The media was perforated and leucocytes were migrating. In eight days little additional change was noted, except an increase in the leucocytic infiltration.

After sixteen days a distinct thickening of the intima was noticed.

After thirty days the inflammatory appearances had in most part disappeared.

4. The intensity of the reaction varies with the intensity of the rays, and the intensity of the rays varies with the distance and with the degree of divergence. More rays strike the center of the area treated than the sides and therefore the degree of reaction will differ.

5. Philipp calls attention to the work of Albers-Schoenberg in which he demonstrated the effect of the Roentgen rays in producing sterility in male rabbits and guinea pigs. The author then demonstrates that sterility may also be produced in man, and cautions radiologists against careless exposures, and asks them to keep this possibility in mind.

6. Hahn treated rodent ulcer of the face with the Roentgen rays, associated with the eosin injections, and thinks that he saw a more rapid decrease in the secretion, and a more rapid healing of the ulcer.

7. This box has no distinct advantage over those constructed in America.

8. This apparatus consists of a stand with a movable screen, and tube which is evenly balanced and so arranged that they always move in parallel.

ZEITSCHRIFT FUR ELEKTROTHERAPIE, LEIPZIG, 1904. VOL. VI. NO. 9.

1. The Iones; or, Electrolytic Therapy. — Stephen Leduc.
2. Electropathology (concluded). — H. Kurella.

1. The author states that the actions of ions may be classed as local and general. The general actions are of utility to the physician and toxic as well as therapeutic doses may be given by electrolytic processes through the skin. With constant density of current the general effects of ions are multiplied by increasing the surface of the electrode. With the present mode of introduction, the medicinal ions are added to, while by the electrolytic method they are substituted for the normal ions, while toxic or injurious ions may be eliminated from the body. The process must be carried on in as careful a manner as asepsis.

Local action must be effectually circumscribed and the application made through an opening in gummed taffeta. These local are most important as they permit of the introduction into each cell of the whole series of ions and also the production of as many different actions as there are kinds of ions. Experimental results show that the actions vary not only with the ions, but also with the dose. The pain due to the introduction varies

with the several ions, some being extremely painful. The zinc ion has proven to be an exceptionally good antiseptic experimentally. In local anæsthesia with cocaine and stovaine the method is not practical, while the salicylic ions are very well supported by the tissues. Author disagrees, by reason of his own experiments, with the general opinion that the electrolytic action is proportional to the quantity of electricity. He finds that the action is proportional to the intensity of current. The action of the ions on the resistance of the body is dependent on the number and nature of the ions and not on the state of humidity and vascularity of the skin. In his studies he found that the ions were susceptible of a variety of actions, caustic, antiseptic, coagulating, of modifying sensibility, conductibility, and vitality, and all may be utilized.

One of the most effective therapeutic actions of the continuous current is its resolute action on ankyloses and sclerous formations, the action varying with the amount of soft tissue covering the part. Extremely good results have been obtained with the salicylic ions in the treatment of left sub-axillary dry pleurisy. In five cases experimented on cures were obtained by two or three applications.

2. Kurella follows the good example set by Jellinek of Vienna to found an electropathology. He has studied the dangers of telephoning, especially for those employed in central stations. He advises certain protective measures to prevent any accidents. In conclusion he says, that it is high time to systematically work out an electrophysiology of man in order to finally evolve an electropathology.

ELECTRO-THERAPY

ELECTROLYSIS AND CATALYSIS

Prof. W. Ostwald, *American X-ray Journal*,
November, 1904.

In a paper read before the International Electrical Congress at St. Louis, a few months ago, Prof. Ostwald sums up briefly the present state of our knowledge on the subject of electrolytic conduction and the phenomena which usually accompany such transfer of electricity. Although the first part of the paper is somewhat historic, stating what others had done before him, the author soon begins to draw from his own experience, and speaks indeed "as one having authority." The complete transference of the electricity through an electrolytic cell is described as made up of two distinct parts, viz., the passage through the liquid, and the phenomena at the electrodes. The first is simply and satisfactorily explained on the ion migration theory of Hittorf. The electrode phenomena, however, while thought at first to be equally as simple, turn out to be quite varied and complicated.

The new important idea was that in many cases the ion which was instrumental in conveying the charges through the electrolyte was not itself deposited or liberated there; that there must often occur therefore at one or both electrodes certain secondary reactions more or less complicated. Perhaps the best known example of this is the decomposition of water by the current, in which process we now know that the small amount of acid added really furnishes the hydrogen and oxygen which appear at the electrodes. From the consideration of the many experimental results obtained, the following conclusions may be stated: "If there are several possibilities for the reaction at our electrode, the chemi-

cal reaction which really occurs depends not only upon the nature of the possible chemical reactions, but also upon the concentration of the substances which are present, and by suitably varying the latter we can bring any reaction to any point in the voltage series."

In the consideration of ordinary electrolysis, whether involving secondary reactions or not, it is supposed that the purely chemical phenomena take place at a speed infinitely rapid as compared with that of the other processes.

Now, it has been shown to be possible under proper conditions to cause certain reactions to occur much more slowly than normal, in fact indefinitely slow in some cases. By such means it is possible sometimes to decide which of two or more possible reactions is really taking place. It is by means of catalyzers in chemistry that it is possible sometimes to change the speed of a given reaction within very wide limits. We may then "by applying suitable catalyzers prescribe to the current that reaction which we want to have take place."

It is at once evident therefore that by the intelligent use of catalyzers that complicated class of phenomena known as electrode processes may be classified, their various stages analyzed and studied separately with an exactness formerly impossible of attainment.

AN EXPERIMENTAL STUDY OF
THE MOVEMENTS PRODUCED
IN THE STOMACH AND BOWELS
BY ELECTRICITY

G. G. Marshall, *Medical Record*, January
7, 1905.

The animals used for these experiments were three cats, one rabbit, and

one white rat. The stomachs of the cats were full of milk at the time of the experiment; the rabbit's stomach was partially distended with half-digested grass and that of the rat was filled with food of a semi-solid nature. The currents used were the faradic, and farado-galvanic, and the technique employed was as follows:

"The animals were put under the influence of ether, and a moist sponge electrode was applied to the exposed stomach, and the other pole was applied to some indifferent part of the animal's body; next both poles were placed on the stomach, one at either end. A similar application to the bowels was then made. In these and subsequent experiments the three currents—faradic, galvanic, and farado-galvanic—were used consecutively. When the galvanic current was used the current was interrupted and reversed.

"Next a small incision was made through the cardiac end of the stomach, just as it appears below the diaphragm. One pole was inserted into the stomach through this incision by means of an insulated copper wire. The other pole, consisting of a damp sponge, was applied to the exterior of the animal's body at different points, and finally was placed directly on the outer surface of the stomach.

"By none of these means could contractions be produced in the stomach or bowels, though when the outer pole was placed on the voluntary muscles the latter were contracted.

"In some of the experiments the electrode on the interior of the stomach, which I will call the internal electrode, was in immediate contact with the stomach wall, while in others it was in contact only with the stomach contents.

"Now the outer sponge electrode was replaced by a metal electrode. This electrode was applied in turn to (1) the outer wall of the stomach, (2) various points on the intestines, and (3)

in the rectum.

"In the experiment with a metal electrode in the stomach and a metal electrode on its outer wall, feeble contractions of its pyloric end could be produced, but none at its cardiac two-thirds.

"By applying the external electrode to the intestines distinct circular contractions were produced at the point of contact. Where the metal electrode touched the intestines the latter immediately became blanched, and then a somewhat prompt constriction took place, making the bowel look as if it had been ligated by a coarse string, leaving scarcely any lumen to the gut. This constriction would not disappear for several minutes. It was only necessary to make a momentary contact to the bowels, when the contraction would begin and continue after the electrode had been removed. If the end of the electrode were wound with a thin layer of wet cotton no contraction of the bowels would be produced.

"With one pole in the rectum, the other electrode still being in the stomach, no movements of either the stomach or bowels could be produced, but the muscles of the back were contracted. The readiness with which the bowel contractions were produced was nearly the same with the faradic, galvanic, and farado-galvanic currents, and the contractions were equally strong with either pole of the galvanic battery.

"Next, one of the pneumogastric nerves was cut down upon and isolated from the surrounding tissues. To this exposed nerve the external pole was applied, the other pole still being in the stomach. No contractions or increased peristalsis of the stomach or bowels could be produced by stimulating this nerve.

"Finally, another incision was made in the stomach, near the pyloric end, and through this opening the second metallic electrode was inserted, the same as had been done at the cardiac end.

Now, with both poles in the stomach, no contractions of this organ could be produced.

"The conclusion formed as a result of these experiments is that the stomach and bowels do not readily contract under the direct application of electricity."

STATIC ELECTRICITY

W. A. Carnes, *Texas Medical News*, December, 1904.

Carnes gives a short, general description of the therapeutic uses of static electricity and reports two cases.

The first was one of dysmenorrhea in a virgin. "A rectal electrode about three inches long, having the portion that comes within the grasp of the sphincter insulated, was inserted into the rectum and connected to the positive pole, the patient in a reclining position. A spark-gap of three to five inches was used, and seances were given twenty minutes daily during the inter-menstrual period. The period, after the first twenty-eight days of treatment, came on without any premonitory suffering, and the patient was able to be up during the time, whereas she had always suffered intensely and was confined to her bed. The treatments were given every other day during the second month and this was followed by like good results. This patient was treated during the past winter and she had no dysmenorrhea up to the time she left here a few months since. Placing the electrode directly back of the uterus and ovaries, relieves hyperæmia of these organs, and will also relieve pelvic neuritis if it exists, at the same time regulating the functions of the stomach and bowels and overcoming constipation."

The second case was one of chorea in a girl 10 years old, which came on suddenly during the night. Patient had always previously been healthy. She was treated for two weeks by the family physician, but with no improvement in the

choreic movements. "When first brought to the office she was very much emaciated, unable to support any of her weight on her legs and feet; frequent incoördinate movements of all the voluntary muscles; inability to talk on account of incoördination of muscles of speech; inability to hold up her head; dribbling of saliva, and restlessness at night were present. The Morton wave current, applied with an electrode one-half by eight inches, placed by the side of the vertebral processes, fifteen minutes, spark-gap one inch at beginning of treatment, gradually increased to three inches, was used. This was followed by negative insulation with positive head breeze for fifteen minutes in daily treatments. After first treatment she seemed to have better control of her muscles, and rested better during the night. After second treatment she could bear her weight on her feet, but there were still choreic movements on any attempt at walking. After third treatment she got up and walked across the room unassisted, and from this time could control the muscles of her lower extremities. After seventh treatment she walked up stairs with some assistance. She now has choreic movements only in arms and face and these are much diminished. She has been able to feed herself for two days. Speech is very much improved. There is some thickness of voice, but she can utter any word that she wants to. She now goes to sleep during each treatment, and her skin becomes moist. Before electrical treatments were begun it was necessary to give enemata to produce evacuation of her bowels, but she has had daily normal movements since the first treatment. Her appetite is good, and she is rapidly gaining weight. There was continued improvement in the symptoms. She was given twenty-one treatments, the only trace of the chorea now being an occasional twitch of an arm or the face."

Carnes is using static electricity in the treatment of tuberculosis, and believes

that it is of benefit in conjunction with other methods.

PHYSIOLOGIC THERAPEUTICS IN THE TREATMENT OF LOCOMOTOR ATAXIA

William H. Walling, *Journal of the Medical Society of New Jersey*, January, 1905.

In this paper the author presents the following routine combination of physiologic methods as having been of great benefit in the treatment of locomotor ataxia.

Morning treatment. Seat the patient upon the cathode and make a labile, anodal application of the combined galvanic-faradic or galvanic current alone to the spine, from the nape of the neck to the buttocks, using a current intensity of ten to fifteen milliamperes, and if the faradic also be used, as much of the secondary coil as will be pleasantly bearable to the patient. The duration of such sitting to be from ten to fifteen minutes. Then place both hands in a basin of warm water, and apply the same stable for from five to eight minutes, intensity five to eight ma. and very mild faradic.

Next, change the basin to the feet, and give the same treatment for the same length of time. Allow one hour's rest, and follow with massage one day, and exercises on the next, alternating from day to day. Avoid fatigue in either case.

Should pain be a prominent factor, the tincture of aconite may be used on

the anodal pad during the labile application.

Afternoon treatment. Apply the static induced current to the hands and feet, five minutes to each extremity, and draw sparks from each side of the spinal column, from the inner side of the thighs, and quite heavy sparks from the soles of the feet. Potential alternations or the Morton wave current may then be given for five minutes, closing the sitting with a short application of the pointed breeze, the latter with a rhythmic motion.

The high frequency current was found to be valuable in arresting pain, but it, like the application of radium, produced no lasting effect. After the use of both remedies the pain returned with somewhat renewed violence. (This result has been noticed in the treatment of other neuralgias with both these agents.)

The anodal, faradic scourge, strongly applied to the limbs, was very beneficial in some extreme cases, affording prolonged relief from pain, and allowing of sleep.

Massage is of great benefit, if properly applied. Only a thoroughly skilled masseur or masseuse should be employed.

Exercise, as prescribed by the physician, should be systematically practiced with the aid of an intelligent attendant, and suspended short of fatigue.

Rules for such exercises are given, also a diagram illustrating them.

Suspension was not used in any case.

Diet, hygiene, cheerful surroundings, and mental diversion were each given due prominence in the treatment.

RADIO-DIAGNOSIS

CEREBRAL SKIAGRAPHY

G. E. Pfahler, *American Journal of the Medical Sciences*, December, 1904.

The paper is based upon a study of

100 brain examinations, part of which were made upon the cadaver, and part upon the living subject.

A series of experiments were conducted upon the cadaver to determine

whether tumors placed in the various regions of the brain could be skia-graphed; different varieties of brain tumors were similarly used and both with positive results.

Tumors were similarly demonstrated in the living subject and subsequently operated upon. Softening of the brain was demonstrated in both the dead and the living subject. Work upon the cadaver always gives an advantage in that the subject studied is absolutely quiet.

A gumma was accurately localized upon the surface of the brain and removed by operation.

A series of experiments were then conducted to determine the best technique. The best results were obtained with an exposure of a half minute with our modern coils, with the anode at a distance of 18 inches from the plate, with a tube vacuum equivalent to a spark-gap of two and one-half inches.

Great difficulty is often experienced in interpreting the shadows obtained, and probably more experience is needed in this respect than is necessary to learn to make good negatives.

The author concludes that we should be able to show in the skiagraph most large lesions, such as new growths, softening, hæmorrhage, and abscess, but that we should never take the responsibility of an operation purely upon skia-graphic evidence.

THE VALUE OF STEREOSCOPIC SKIAGRAPHY WITH PRACTICAL DEMONSTRATIONS

Mihran K. Kassabian, *N. Y. Med. Jour.* and *Phila. Med. Jour.*, Dec. 31, 1904.

Kassabian differentiates between a photograph which is a reflected picture and a skiagram which is a silhouette only, therefore flat and lacking perspective. The former is obtained by the stereoscopic method, which is difficult and complicated.

In stereoscopic skiagraphy two negatives are made on two plates without disturbing the position of the part, the position of the tube being shifted $2\frac{1}{2}$ inches for the second exposure; the negatives or prints therefrom are examined by a special instrument. A skiagram should first be made to determine the exact nature of the injury. In making the stereoscopic picture the object is centered, then the tube is moved to the right $1\frac{1}{4}$ inches and the plate exposed and marked "right." The tube is then shifted $1\frac{1}{4}$ inches to the left of the center, a second exposure made and this plate marked "left."

He describes and illustrates a table which he has devised for facilitating this work, which is provided with a device for holding the tube and graduated so as to show the amount of displacement of the tube, and an adjustable plate changing box.

He prefers to place the plate above and the tube below the part, thus avoiding distortion due to the weight of the body or part.

The tube must hold the same vacuum for each exposure and the time of exposure should be equal in both instances.

Development requires care in order to obtain the same degree of density in each negative.

He prefers the ordinary Wheatstone reflecting stereoscope for examination of the negatives.

The principal advantages of the method are increased definition and depth of the observed image, and the possibility of location of foreign bodies. The two images being practically superimposed, the density of shadows is doubled. This is a decided advantage in the diagnosis of such lesions as brain tumor, showing very faint shadows.

In fractures and dislocations a more accurate judgment of the nature of the injury is possible by this method than when ordinary skiagraphy is employed.

He believes the results obtained jus-

tify the extra time and labor necessary.

THE RELATION OF RADIOGRAPHIC APPEARANCES TO CLINICAL SYMPTOMS IN HIP DISEASE

Robert W. Lovett and Percy Brown, N. Y.
Med. Jour. and Phila. Med. Jour.,
January 28, 1905.

One hundred consecutive negatives of the hip joint were taken from the files of the Children's Hospital, X-ray department, in Boston, and studied to determine what value the radiograph alone possessed as a factor in detecting hip joint disease, especially in its early stages. The negative was identified by number, examined, and the opinion as to what it indicated written. These opinions were then compared with the clinical history. The results led them to conclude that radiographs "are of great value in the hands of persons of average experience; that a radiograph free from abnormal appearances does not show that hip disease is absent or will not develop, but that in a case of doubtful clinical diagnosis a normal X-ray is a matter of weight and makes the likelihood of speedy recovery greater than will radiograph with abnormal appearances.

"The existence of slight atrophy of bone and slight diminution of shadow, while on the other hand, not showing that hip disease was present in a case of doubtful clinical diagnosis, makes the likelihood of it greater and the outlook rather more serious than a normal radiograph would do.

"In only two cases was hip disease diagnosticated where it was not present, and here the writers were misled by an extra-articular collection of pus. In three cases out of the hundred the opinion expressed was wholly wrong. In the remaining ninety-five, the opinion formed from the X-ray was fairly well

borne out clinically."

The earliest changes observed radiographically in hip disease are, first, diminution in the density of the shadow, and second, a relative diminution in the size of the shadow cast by the affected bone: in other words, atrophy of the bony substance.

The best radiographic evidence is considered to be bony thickening indicated by a shadow projecting inward from the pelvic side of the acetabulum; the head and neck of the femur also sometimes showed this evidence.

Decreased radiability observed as "an indefinite, cloudy appearance, which involves not only the bony medulla, but the cortex and periosteal structures as well," are frequently seen. This cloudiness was found to be due to the presence of thick serum, pus, or finely divided detritus, and is apt to be misleading if depended upon to the exclusion of other indications. It was sometimes observed where the inflammatory process was extra-articular, as in abscess of the groin.

Erosion of the bone substance, when present, is usually clearly evident in the plate, but is not of itself conclusive evidence that hip joint disease is present.

FOREIGN BODIES IN THE ESOPHAGUS

Carl E. Black, *American Medicine*, January 28, 1905.

Two cases are reported of foreign bodies in the esophagus, in one of which removal was accomplished under Roentgen radiation when other methods had failed.

The first case was that of a girl, aged 14, who had accidentally swallowed a pin. During the ten days following the accident a bristle probang was used several times without result. A skiagraph was then taken, which showed the position of the pin, when its removal was

accomplished by forceps introduced through the mouth and guided under fluoroscopic observation. During this operation the patient lay on a table with her head drawn over its end and held by an assistant. The Crooke's tube was located under the table so that the operator could use the fluoroscope with his left hand and direct the forceps with his right. Patient was of course anesthetized. Patient's recovery was immediate and complete.

The second case was that of a boy 10 years old, who had swallowed an iron washer, an inch in diameter, while asleep. Six days after the accident he was examined fluoroscopically and the washer was discovered at about the level of the interspace between the first and second ribs. Patient was anesthetized and efforts made to extract the washer under fluoroscopic observation. Although it could be easily grasped by forceps it could not be dislodged by any ordinary method and the patient was sent to the hospital for operation. This was postponed until morning, when the patient suddenly rose up in bed and vomited a quantity of partially-digested food and stomach fluids, lay back on the pillow and expired almost immediately. No post-mortem could be secured.

Black considers that these two cases illustrate very well the value of the Roentgen ray in dealing with foreign bodies in the esophagus, and that it is most useful in supplementing esophagoscopy, the use of sounds and probes, etc. There are some conditions in which the esophagoscope is counter-indicated, as in cases of abscess for instance. Foreign bodies may be accurately located by taking skiagraphs in two or three different planes and the Roentgen ray becomes most valuable in such cases. Fluoroscopy is most valuable as an aid in directing and controlling instruments in the esophagus.

SKIAGRAPH OF AN OLD UNUNITED FRACTURE OF THE SCAPHOID BONE ILLUSTRATING THE VALUE OF THE X-RAY IN THE DIAGNOSIS OF SUCH FRACTURES.

Levi J. Hammond, *Medicine*, January, 1905.

The patient was a man 21 years old, who consulted Dr. Hammond for a pain in his right wrist, from which he had been suffering for two years. There was no tenderness or any visible signs of inflammation and the pain was intensely present only when the wrist was abducted. The condition had been treated by various physicians previously as rheumatism, sprain, tubercular perioritis, and tenonitis without relief.

Hammond investigated the condition radiographically and found that the trouble was due to a fracture of the scaphoid bone, the fragments of which were united by a very loose fibrous connection. It would have been absolutely impossible to have made this diagnosis without the aid of the X-ray.

The trouble was entirely remedied by cutting down upon the fragments, removing the interposed fibrous tissue and wiring the pieces together.

TRANSILLUMINATION OF THE STOMACH

H. W. Lincoln, *Brooklyn Medical Journal*, January, 1905.

Various substances which might increase the illuminating power of a lamp in the stomach, such as quinine, a decoction made from the horse chestnut, and fluorescein, have been used, but the author considers that the last-mentioned gives the best results. It is used in a strength of $\frac{1}{8}$ or $\frac{1}{4}$ of a grain to the pint of solution.

Transillumination is a good diagnostic aid in certain cases and is practically applicable, no matter how thick the ab-

dominal wall; the average weight of the patients who have been subjected to this method by Lincoln is one hundred and thirty-six pounds.

He uses a lamp which he designed some four or five years ago. It consists of a small capsule, having an incandescent light in one end and connected with the battery by fine copper wires enclosed in a small rubber tube a little larger than an ordinary match-stick. His technique is as follows:

"The examination may be made in the morning on the empty stomach or in the evening, the patient having fasted since noon. For convenience I have at hand a bottle which holds one part of the solution, which consists of one 1/8 grain tablet of fluorescein, 40 grains of sodium bicarbonate, 1 or 2 drachms of glycerine, and the balance of water. This does not deteriorate on standing, as I used one specimen which had been prepared for over six weeks, and got a good result. In most instances, it is better to allow the patient to introduce the lamp for himself. It inspires confidence, and the capsule goes easily down, and after that the cable gives no trouble.

It is advisable to have the lamp swallowed before the solution, so that in the event of any slight irritation the stomach will be perfectly empty. The heat thrown out by the lamp is minimum, and immersed in solution is nil. With the lamp in the stomach, allow the patient to drink the fluorescein solution. Have the abdomen bared, and turning down the light in the room or going into a dark room, connect the diaphane with the battery and you will have no trouble in seeing the illumination through the abdominal wall. Mark the outlines of the shadow with some soft substance, such as dropped chalk, and coming again into light measure transversely, vertically, and the distance of greater curvature above or below the umbilicus. This outline may be with suitable accuracy transferred at sight upon an abdominal chart made by rubber stamp or otherwise."

The author's experience with transillumination in thirty cases causes him to conclude that "the vast majority of stomachs in the healthy male and female lie below the boundaries usually given as normal."

RADIOTHERAPY

THE TREATMENT OF MALIGNANT DISEASE OF THE BREAST

Charles Lester Leonard, *St. Louis Medical Review*, December 10, 1904.

Leonard considers that there are two conditions in malignant mammary disease wherein the use of the X-ray to the exclusion of primary surgical ablation may be justifiable; first when the tumor is hard and of the well-known scirrhus variety, and second, when the tumor is sarcomatous, because sarcomas are considered by some to yield more readily to Roentgen treatment if they have not pre-

viously been operated upon. Conclusions which he draws are as follow:

"Our knowledge of the etiology and pathology of malignant disease is very limited.

"The natural benignity of atrophic scirrhus is apparently explained by certain pathologic changes that show an attempt by nature to retard the progress of malignant disease.

"The results produced by Roentgen treatment are practically identical with this natural process, but are more complete, showing a power over the malignant cells themselves.

"Conservative surgery tends towards a non-operative treatment of hard cancers (atrophic scirrhus) and their treatment by Roentgen rays.

"Early radical removal by surgical operation is indicated in all other primary growths and operable recurrences, to be followed by early Roentgen treatment.

"Post-operative Roentgen treatment has been shown to have great value. It should be employed to supplement all operations. Immediately after operation it gives the patient the advantage of one method supplementing the other.

"The beneficial results of this, as with all other therapeutic measures, are proportionate to the knowledge and skill of the person employing them. These factors must be taken into consideration in judging the results of any method of treatment."

COMPARISON OF THE TREATMENT OF SURGICAL TUBERCULOSIS BY MEANS OF RADIOTHERAPY AND SURGERY

James B. Bullett, *American Medicine*, January 14, 1905.

The author has gone to considerable pains to collect statistics regarding the use of radiotherapy in surgical tuberculosis; he points out the liabilities to error by means of tables. His labor has resulted in the collection of a large number of cases from about forty-eight operators, which show a large percentage of cures.

He has collected 518 cases of surgical tuberculosis from 48 observers, involving the bones, joints, tendon sheaths, peritoneum, testicle, and lymphatic glands, and 616 cases of tuberculosis of the skin (lupus) with 68 per cent. cured, 24 per cent. improved, and 8 per cent. unimproved.

No statement is made about the tech-

nic, or the elapsed time since the cure has taken place. The result in percentage from the work from different operators, has run very uniformly. Tuberculosis of the peritoneum shows 40 per cent. of cures, while tuberculosis of the testicle shows only 33 per cent. In tuberculosis of the long bones he shows 36 per cent. cured, 35 per cent. improved, and 29 per cent. unimproved; the best results were obtained in tuberculosis of the tendon sheaths, 70 per cent. being reported as cured, 22 per cent. as improved, and 7-10 per cent. as unimproved.

He compares the danger attending surgical interference with the safe and simple technic of radiotherapy, but quotes from authority to disprove the accepted theory of general practitioners that tuberculosis is disseminated by surgical operation, as hospital statistics covering periods of time before the dawn of modern surgery showed as high a mortality as has been shown since surgery appropriated these cases. He calls attention to a fact that is frequently overlooked, viz., that it is the vital resistance, as well as the recuperative power of the patient that will determine the outcome of the case.

Operating upon a case where mixed infection has not taken place, or where mechanical appliances are capable of bringing about a cure, is disapproved. Surgeons would welcome any system of treatment that would remove this class of cases from their care, and he thinks the Society owes it to the world at large to perfect the treatment and collect its statistics in such a manner that they cannot be questioned, whereby it may be demonstrated beyond the shadow of a doubt that radiotherapy is *the* treatment for surgical tuberculosis.

The paper shows an infinite amount of labor, and is of great value as being the first set of statistics collected upon this important subject.

THE X-RAY TREATMENT OF LEUKÆMIA

J. C. G. Ledingham and R. G. McKerren,
London Lancet, January 14, 1905.

The literature concerning the X-ray therapy of leukæmia is very fully reviewed in this article and includes cases reported by Senn, Bryant, Crane, Reincke, Krone, Ahrens, Aubertin, Beaujard, Guilloz, Spillmann, Capps, Smith, Ridbe, Fried, Schweinberg, Schenck, Cahen, Joachim, Kurpjuweit, and Grawitz, the number of authoritative contributions to this literature now being sufficient to entitle the method to serious consideration. Ledingham and McKerren contribute another case which also demonstrates that the X-ray is capable of powerfully modifying the symptomatology, at least, of this mysterious and intractable disease.

The patient was a boy 11 years old who had been an inmate of the Royal Hospital for sick children, Aberdeen, for eighteen months previous to the beginning of the X-ray applications. He was a victim of spleno-medullary leukæmia and exhibited the characteristic blood picture with enormous enlargement of the spleen. There was present emaciation, weakness, and marked distention of the abdomen, but no obvious anæmia. Lower border of spleen extended to within a finger's breadth of the pubis, anterior border two inches beyond middle line. Red cells 3,570,000, white cells 234,000, hæmoglobin 80 per cent. For a few days after his admission to the hospital his ordinary body temperature was 100° to 101° F. As the result of rest in bed it then became normal, but when he was allowed to get up and about it would always go up again to 102° or 103° F. Intermittent elevations of temperature not traceable to specific causes also obtained. As arsenic was not well borne, the treatment consisted of rest and dietary regulation. This condition continued practically without change un-

til the X-ray was applied, the spleen steadily increasing in size.

Radiation was begun May 17, 1904, the splenic tumor, lower epiphyses of the femora, and occasionally the sternum and vertebra being exposed for from 10 to 15 minutes every other day, the tube (whether anode or glass is not stated), being located five inches from the skin. It is to be regretted that the degree of tube vacuum or ray penetration is also not stated. No symptoms of toxæmia traceable to the radiations were observed throughout the entire course of treatment.

At the end of the first six weeks of treatment the leucocytes had reduced to 23,000 from 222,000 noted on the first day, and during this period the red cells averaged 4,500,000, sometimes reaching 5,000,000. Hæmoglobin remaining steadily at from 55 per cent. to 60 per cent. As the leucocytes diminished the myelocytes, which had previously been the predominating cell, fell to second place, the polymorphonucleas taking first, the ratio of polymorphonucleas rising from 0.5 before radiation to 2.0. The blood did not become entirely normal, therein differing from some other cases reported. Very little effect was observable upon the size of the spleen, which the authors think may be due to the fact that extensive fibrosis is known to obtain in old leukæmic tumors, and this condition may often render reduction of the tumor impossible.

The effect of the radiation upon the patient's general condition is described as follows:

"Previously to his treatment the patient was more or less bed-ridden, owing to the invariable rises of temperature that the mere getting out of bed and lying on a couch produced. Further, walking was always difficult, and breathlessness with face-flushing exceedingly troublesome. However, within a month after the commencement of the treatment the patient felt distinctly better, and was

able to walk down to the Roentgen ray room, and, after exposures, to climb the stairs leading to the ward. In fact the boy walked with the greatest ease and without any bad effect or even rise of temperature."

On May 9, 1904, the patient weighed 4 stones 6 lbs; on November 21st, 5 stones 1 lb. 8 oz. His condition has continued good, and further details regarding the future progress of the case are promised as they develop.

MYELOGENOUS LEUKÆMIA, WITH REPORT OF A CASE. X-RAY RESULTS.

Dr. Elliott, Jr., *New Orleans Medical and Surgical Journal*, January 1, 1905.

The disease occurred in a white man, age 43. The diagnosis was based upon the complaint of pain in the region of the spleen, marked enlargement of the spleen, some enlargement of the liver, and a blood examination which showed myelocytes, 45 per cent.; red blood corpuscles, 4,000,000; white corpuscles, 160,000.

The case was treated by Dr. Guthrie every other day. In two months the blood count gave red blood corpuscles, 4,400,000; white blood corpuscles, 50,000; myelocytes, 4 per cent.; normoblasts were present but no megaloblasts; hæmaglobin, 55 per cent. Spleen became smaller and pain in the bones lessened.

After five months the red blood corpuscles were 5,060,000; whites, 68,000. Treatment was suspended. Within a month he developed signs of spinal irritation, and later signs of hemorrhage into the cord, and he died in about five weeks after the onset of these symptoms. The spleen had grown progressively larger.

The author then reviews the various theories as to causation, and agrees

that it is probably cancerous in nature.

The author has collected from literature 15 cases of myelogenous leukæmia, including his own.* Of the 12 cases followed to September, 1904, six have died, four have relapsed, two are stationary or improved, and yet only 18 months have elapsed since the first case was treated.

From a study of these cases he concludes that the X-ray has no advantage over arsenic in the treatment; that it causes the spleen to shrink, relieves the pains in the bones, and causes a reduction in the leucocytes is undeniable, but similar and just as permanent results have been obtained through other less dangerous and less expensive methods.

He is inclined to believe that the X-ray may do harm in causing a sclerosis of the spleen and bone marrow, and thereby giving only temporary relief, with an aggravation of symptoms later.

PROTECTION OF THE X-RAY OPERATOR IN HIS WORK

R. Kienbock, *Wiener Klin. Wochenschrift*, 1904. No. 51.

The author describes the methods employed for the protection of the X-ray worker against the deleterious effect of the rays:

1. The operator remains behind the anticathode within the non-active field.
2. He avoids coming near the radiating tube.

3. Use of metallic screens.

According to the manner of placing the protecting device three methods can be distinguished:

1. The physician covers the exposed portions of his body with sheet lead or the like.
2. Lead plates are placed between physician and tube.
3. The tube is placed in a box or covered with a shield.

THE FINSEN METHOD

Milton Franklin, *Medical News*, December 31, 1905.

Franklin describes the early apparatus for actinotherapy and the original Finsen lamp, with its defects in construction, etc., and relates the attempts to substitute for it a smaller, less expensive, and more efficient instrument.

The first attempt resulted in the production of the Bang lamp, which consisted of a pair of water-cooled iron electrodes carrying three amperes and provided with a simple quartz disc used as a compressor. The Kjeldsen and Dermo lamps are copies of this lamp.

The other type was the Lortet and Genoud, of which the familiar London Hospital lupus lamp is an imitation.

He describes the Piffard lamp, which he claims is the most efficient known for the amount of energy required, and which is capable of producing a superficial dermatitis in ten minutes. He refers to many ludicrous forms of lamps made in this country which contain glass through which the light frequencies must pass, and denies the statements of the makers that any glass will transmit ultra-violet rays in quantity sufficient for therapeutic use. He sums up the reason why this method has declined in favor in most countries and why failure has been the lot of many operators, as follows:

"At the Finsen Institute constant efforts were made to simplify the apparatus, but nothing was accepted without having proven its superiority. The reason for their success is that they retained the old imperfect apparatus, which, by the way, had demonstrated that if given time it would do the work, instead of accepting on the word of the enthusiast every silly toy that was heralded as better than the original." "The treatment was originally invented for the cure of lupus vulgarus, and that fact has not been forgotten."

The new Finsen-Reyn lamp is described fully, and the writer considers it a valuable and efficient lamp. It consists of an automatic 25 ampere lamp mounted on an optical table. The carbons are inclined at an angle of 120° to each other, and the upper forms an angle of 56° with the lens tube. This is a ten-inch barrel containing the lenses and cooling system. All the lenses are of rock crystal and have an aperture of $3\frac{1}{2}$ inches. The lamp delivers light at 110° F. and this is cooled again in the compressor.

The objection to the iron and spark lamps is the superficial nature of the reaction produced, as well as the severity of this reaction, which often necessitates cessation of treatment. Most cases supposed to be cured by these lamps usually recur, owing to the failure of the light to penetrate deeply enough. "The successful practice of the method requires a slow, even effect, gotten through a great depth of tissue."

In lupus erythematosus the Piffard lamp is superior to the Finsen lamp. He considers the Finsen method, properly applied, superior to all others in the treatment of lupus vulgarus, and states that Copenhagen is the only place where the Finsen light is so applied.

The statement that the X-ray is a specific in lupus he declares not proven, and expects to find in high frequency a valuable form of treatment for this disease.

REPORT ON THE PROGRESS IN ACTINOTHERAPY DURING THE PAST YEAR

William S. Gottheil, *Journal American Medical Association*, January 28, 1905.

The diseases in which actinotherapy (electric arc light) is pre-eminently useful are lupus vulgarus, tuberculosis verrucosa, scrofuloderma, tubercular ulcer-

ation, post-mortem tubercle, and possibly lupus erythematosus. Some cases of joint tuberculosis have been reported cured and the method has been used with great success in obstinate acne. Some have also used it in tuberculosis of the internal organs, rodent ulcer, epithelioma, and cancer, alopecia areata, nevus, etc., but we are not yet in a position to make any positive statements regarding its efficacy in these diseases.

Gottheil thinks that lupus is more common in this country than is generally supposed; he reports having seen about thirty cases within the last two or three years.

The only rays which he believes should be excluded are the red thermic rays; although the violet and ultra-violet rays are the most active, all those occupying the central spectral region are effective and should be utilized.

A lamp using less than forty amperes of current is not considered to be effective therapeutically. Although many lamps using a greatly less volume of current than this will give a strong surface reaction, yet this does not mean that requisite tissue penetration is secured; in fact Gottheil believes that a strong surface reaction is evidence that the light does not penetrate. As an apparatus he prefers the actinolyte, in which machine the two condensing lenses are so arranged as to form the sides of a receptacle for water. This arrangement cuts out the heat rays and does away with the danger of lens breakage through the use of too great a heat. He prefers the ordinary arc carbons to terminals made of iron.

The promise given by the use of erythrosin and other substances of a fluorescent nature, when injected into tissues or painted on the skin, in the way of intensifying the effects of the electric light, is believed to be good, but enough work has not yet been done with it to render judgment possible.

Incandescent lamps, no matter how

great their number, are believed to be useless for the purpose of actinotherapy; they produce a large volume of thermal rays, but that is all.

RADIUM, ITS VALUE IN MEDICINE

Myron Metzenbaum, *The International Clinics*, Philadelphia, Pa.

This paper presents a short history of the development of the X-ray and Fin-sen light and their value as therapeutic agents in the treatment of lupus. It then deals with the author's personal observations as to the physiological action of radium and its value in the treatment of lupus, rodent ulcer, and small epithelioma, as follows:

When radium of at least 7,000 activity contained in hermetically sealed tube is placed on the unbroken skin for a period of at least three hours it may produce an irritation which may finally result in ulceration of the skin.

When tubes containing radium of 15 grains each of from 40 to 100 activity and one tube of 20 milligrams 7,000 activity are placed on ulcerated areas, they produce sensations not unlike the feeling one experiences in a burn when standing near a hot stove. The radium also causes a peculiar pink injection of the ulcerated and surrounding tissue, which may last from a few hours to as long as 16 hours.

From very careful observations no difference could be noted in the physical or therapeutic results when using radium of 100 activity or 7,000 activity.

REPORT OF CASES

In all cases the tubes of radium were placed directly on the area to be treated and held in position by strips of adhesive plaster. A treatment was given every three or four days for thirty-five to forty-five minutes each time. No internal treatment was given, and, excepting the

application of hot water to the diseased parts, no local treatment whatsoever was used.

Case I. — Rodent ulcer in a woman, age 57, extending from the middle of the right supra-orbital ridge to within $2\frac{1}{2}$ centimeters of the ear and well down on the cheek, causing a loss of the eye. The X-rays had been applied for a period of 8 months, but the ulcer continued to spread. Applied tubes of radium of low activity on April 14th; after 15 days ulcerated surface had healed over. Photograph taken after 40 days shows entire ulcerated surface replaced by firm white scar tissue. No applications have been made within three months, and excepting two small spots the entire ulcerated surface has remained healed.

Case II. — Male, age 27. Four years ago lupus developed to the right of the chin, covering an area of $1\frac{1}{2}$ inches in width, 3 inches in length. The ulcerated area was dissected out and followed by a course of X-ray treatment. The surface healed, leaving a scar of very firm fibrous tissue, which drew down the right angle of the mouth, causing an impediment in his speech. February, 1904, an ulcer, the size of a quarter, developed the left side of the scrotum. This did not heal under various methods of treatment for a period of three months. May 23d, applied radium of low activity to the ulcerated area, and after three applications the same healed and has remained well ever since. To the old scar on the face radium of low activity was applied at four different times. This caused the firm fibrous scar tissue to become soft and pliable, so that the angle of the mouth was no longer drawn down to the same degree, nor is it as apparent as before.

Case III. — A young lady, age 22, has large lupoid area 5 centimeters in length, $2\frac{1}{2}$ centimeters in width, which has healed after 12 different cauterizations, leaving a rather rough and firm scar. Around this healed area was a rim of 1

centimeter in width which was red; in many places there were small denuded areas; in all there were 15 applications of the tubes of radium, which caused the red rim to disappear and the small ulcerated areas to heal; also the firm and somewhat rough old scar became soft and pliable, so that it is but slightly noticeable.

Case IV. — Woman, age 71, developed a small epithelioma on the right of her cheek, measuring $1\frac{1}{2}$ centimeters in diameter. The glands of the neck were not infiltrated. The radium was applied nine different times and caused the depression to fill in and heal over. Three months have elapsed since the last treatment, and excepting for a slight redness of the area nothing would be noticeable.

Case V. — Woman, age 32, has very extensive lupus vulgaris extending over the entire right side of her face from the ear up into the scalp, down to the cheek and back to the angle of the jaw and around to the chin. Various methods of treatment had been tried during many years. The photograph was taken thirty days from the beginning of treatment, during which time she has had 14 applications, and it may be seen that great numbers of the elevated areas have smoothed down and that there is a great amount of new intervening scar tissue, which is soft and pliable. Due to illness no applications have been made within two months and all the healed areas have remained well, so this case gives very fair promise of becoming entirely well.

Case VI. — Woman, age 40. Had a mole above the right supra-orbital ridge. She persistently picked at this until, as she says, she pulled it out clear from the root. Two and one-half months from this time I saw her. There was a deep hole where the wart had been, with a diameter of 2 centimeters, extending down to the periosteum of the bone; the edges were highly inflamed as well as the surrounding tissue, and there

was a discharge of blood and serum. This is undoubtedly an epithelioma developing by irritating the mole. She has received eight applications of radium in the period of thirty days and the deep ulcerated surface has filled in and healed over so as to be barely noticeable.

CONCLUSIONS

1. From these cases the following inferences may be drawn, namely: that with rays coming from radium which is contained in hermetically sealed tubes placed directly on an ulcerated area, a slight sensation will be felt in from seven to eight minutes, but when the skin is unbroken, no sensation is felt, even if the tubes of radium remain on for a period of thirty-five minutes.

2. If these tubes of radium are kept on an ulcerated area for a period of thirty-five minutes they produce an increased redness of the diseased part and cause an erythema of the surrounding healthy tissue, which may last for several hours, or as long as twenty-four hours.

3. That radium rays have caused an ulcerated lupoid area in three cases, an ulcerated area of a rodent ulcer, and two small epitheliomas to heal over, and that these former ulcerated areas may become firm white scar tissue, which gives them every appearance as though they were healed and in one case of very extensive lupus vulgaris it has produced such marked improvement that the case may be considered as healed.

4. That the rays of radium have caused the firm, rough scar tissue in two cases of old lupoid scars to become soft and pliable, and therefore they appear less disfiguring.

5. These effects of radium have been very rapid, considering the usual intractability of this class of disease and considering that in all cases various therapeutic measures and means had been tried repeatedly with little or no effect.

6. What is of very great practical value if radium has a therapeutic use, namely, these results have been obtained

with tubes of radium of low activity costing but a few dollars, while it was supposed that only radium of high or very high activity, costing several hundred dollars a tube, possessed any therapeutic properties.

7. The treatment in none of these cases was commenced longer than six months ago, and while four of these cases have remained healed for a period of three months, yet many months or even years must elapse to see whether the disease will not reassert itself again before the same can be pronounced as cured. And if after a lapse of several years cases of lupus, rodent ulcer, or epithelioma treated by the aid of radium remain cured, then radium is only to be classed with the Finsen light and the X-rays as one of the therapeutic agents in the treatment of lupus and with the X-rays and surgery as one of the methods in the treatment of small epithelioma and rodent ulcer.

8. Two radiographs of a false joint of the ulna are shown and constitute a very good example of the comparative value of radium and X-rays in the examination of bones directly. The X-radiograph was a three-minute exposure, while the radium picture was a one-week exposure; from which can be concluded that the X-ray shows far greater differentiation between the bone and connective tissues than does radium, and since it requires at least several hours for the radium rays to penetrate the flesh it would therefore be impracticable to use radium for making skiagraphs.

9. The conclusions drawn from nearly one hundred experiments give positive proof that while suspending tubes of radium of various strengths for long periods in various solutions and various powders, that neither these solutions nor the powders are capable of affecting photographic plates, and are therefore not rendered radio-active and can in no wise affect the metabolism or pathology of living organisms.

MECHANOTHERAPY

VIBRATORY MASSAGE IN GENERAL PRACTICE

Wm. Gray Schauffler, *Journal of the Medical Society of New Jersey*, January, 1905.

Mechanical vibratory stimulation is considered a better term than the one used as a title, and Schauffler divides his treatment of the subject into four sections as follows:

1. Of what mechanical vibratory stimulation consists.
2. What it can be used for.
3. How to apply it.
4. What may be expected from its use.

"Physiology teaches us that 'pressure exerted on a nerve causes it to vibrate, or increases its natural impulse.' With this fact as a guide it has been shown that various degrees of pressure elicit corresponding rates of nerve vibration. When to the mechanical pressure exerted is added artificial vibration by means of some mechanical contrivance so arranged as to give many hundred strokes per minute, we find the 'natural impulse' of the nerve to vibrate even more increased. Finally, having at hand an ingenious mechanism by means of which we can at will increase or diminish both the frequency and the power of the stroke, we find it within our power to gently stimulate a given nerve, to cause it to vibrate forcibly, or even to produce inhibition therein.

"Stimulation is produced by a medium stroke and light pressure. This is the degree of treatment that will be found most efficacious in the majority of cases for increasing the blood supply to a given part and improving nutrition and the general tone. It is always applied with the brush.

"Vibration is produced by a heavy stroke and deep pressure. It should only be applied to inhibit a nerve that is

communicating a sensation of pain, and to relieve congestion or engorgement of an organ. For this the ball is used.

"Vibratory stimulation is produced by a medium or fairly heavy stroke and varying pressure, and will be found preferable where there is pronounced inaction or atony. It should be applied to the spine by means of the ball. For this degree of treatment tolerably deep pressure is advisable.

"Mechanical vibratory stimulation is capable of:

"1. Increasing the volume of the blood and lymph flow to a given area or organ.

"2. Increasing nutrition.

"3. Improving the respiratory process and functions.

"4. Stimulating secretion.

"5. Improving muscular and general metabolism, and increasing production of animal heat.

"6. Stimulating the excretory organs and assisting the functions of elimination.

"7. Softening and relieving muscular contractions.

"8. Relieving engorgement and congestion.

"9. Facilitating the removal, through the natural channels of the lymphatics, of tumors, exudates, and other products of inflammation, relieving varicosities and dissipating eruptions.

"10. Relieving and inhibiting pain."

To give good results the instrument used must be easy of manipulation, under perfect control as regards length of stroke and pressure, and transmit to the patient all the vibrations produced.

For the application the patient removes all tight clothing and lies prone on a suitable couch or low operating table, thus giving the operator easy access to the spine.

The length of the stroke and amount

of pressure to be used having been determined upon in each case in advance, the operator then proceeds to apply the vibration to the spots needing it. Holding the motor in the right hand, the left thumb and forefinger are used as guides, never applying mechanical pressure without first having thus tested the spot. In this way much unnecessary discomfort on the part of the patient is avoided. The length of time required for each treatment varies from 4 to 8 minutes, rarely more. After rising from the couch, the patient should recline in a low chair for a few minutes of rest and relaxation.

While the various organs may frequently be stimulated locally with advantage, yet the larger part of the treatment should be applied to "the inter-

stices of the transverse processes of the spinal vertebræ, which are immediately over the posterior division of the spinal nerves;" the general theory upon which this treatment is based, being that all the functions and organs of the body are controlled by certain nerves or nerve centers located principally in the spinal cord, and that in the course of disease, if these centers are reached and treated, restoration to normal action may be expected in most cases.

Schauffler believes that this therapeutical modality occupies "a well-defined place as a most valuable aid to the general practitioner, enabling him successfully to treat a large class of cases which he has heretofore thought it necessary to turn over to specialists or send to sanatoria."

FOREIGN LETTER

Frankfort-on-the-Main, Germany, December, 1904.

ON THE TREATMENT OF NERVOUS DISEASES BY VIBRATION

Strictly speaking, this therapeutical modality belongs neither to electrolology or radiology, but more especially to the great territory of massage. Although the motive force actuating the apparatus which I and others have used with success, and which I shall presently describe more precisely, is electricity, yet the curative element utilized is not the current entering into the body, but the effect of the mechanical vibrations on the skin, with their resultant physiological effects on the functions of the nerves which supply the blood vessels of the human body. Electro and vibrotherapy are, however, considerably analogous physiologically, in some ways.

In Germany vibration is employed a great deal by electrotherapists, especially in those medical establishments which

deal with the mechanical treatment of constitutional pathology, metabolic aberration and heart diseases as well as affections of the nerves and muscles. Furthermore, everybody who has ever used vibration for the treatment of nervous diseases will be aware of certain analogous facts which exist between the remedy just named and some other therapeutical agents. Our American colleagues are sure to know that Moebius and Schultze, two celebrated German scientists, wrote several essays about fifteen years ago expressing doubt as to the actual physical effect of the electric current, attributing its beneficial influence to suggestion.

Erb, Eulenberg, Bernhardt, Hann, and others have refuted such claims repeatedly, and especially so on the occasion of an electrotherapeutical congress, which was organized by Prof. Dr. Edinger and the author of this article dur-

ing the electrical convention in Frankfort in the year 1894. Some celebrated electro-therapists argued against them. Then followed a publication on "The Electrotherapeutical Matter of Controversy" (D. & F. Bergmann, Wiessbaden), that contributed a great deal to the clearing up of the disputed questions. The controversy then stopped. If I am to look over the results of an experience of 25 years as a nerve specialist and electrotherapist, during which time I employed the electric current every day in different ways, my judgment about it can only be as follows:

(1) The galvanic and faradic currents belong to the most important remedies for nervous and muscular diseases, *provided* that they are administered with a properly and intelligently regulated degree of volume and potential, and provided that a strict consideration be given to physical, anatomical, and physiological fundamental doctrines.

(2) Neuralgia and peripheral affections that do not result from profound degenerative processes of the nervous system can be healed by the application of the current.

(3) Subjective troubles and disturbances of function which are caused by disease of the central nervous organs can be moderated and removed by electricity. The current does not seem to have any influence on the anatomic processes from which such disturbances primarily result.

(4) In the treatment of the so-called functional nervous diseases (neuroses) the electric current proves itself a highly useful remedy, eminently qualified for their treatment. It acts also through the skin as a stimulant, like other physical remedies of like nature, stirring up the nervous system in a beneficial way.

(5) The success obtained by the use of electricity in nervous disturbances is due less, perhaps, to the regeneration caused by electrical influences upon ana-

tomical structure, cataphoric, catalytic, etc., than to the biological effects of stimulation (the "Bahnung" and the "Hemmung" on the functions of the neuroses,) which phenomenon is worthy of earnest consideration in this connection. (L. Laquer, "General Electro-therapy," published by Urbans & Schwarzenburg, Vienna, 1898.)

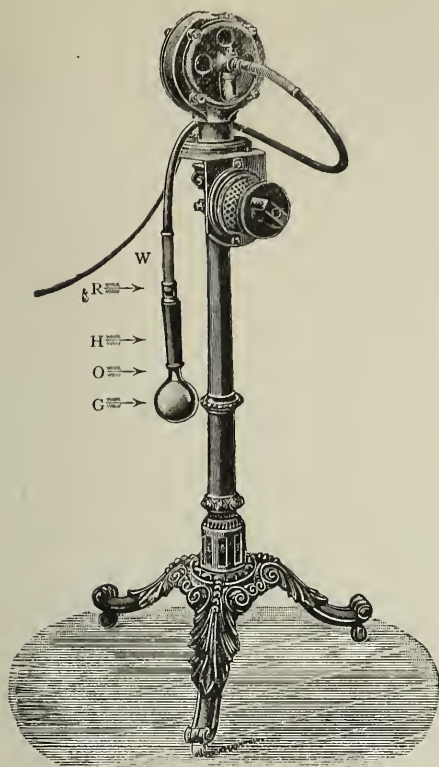
Since most practitioners doubtless use the electric current without regard to the rational method just mentioned, the confidence of the patients in the therapeutic effect of electricity is disappearing rather than growing. The specialist often encounters opposition when he advises treatment with electricity because, especially in chronic nervous cases, it has been tried without benefit and has had a discouraging effect.

The "nil nocere" has been forgotten by the physicians; they have applied electricity for too long a time and too strongly and they have used the "brush." No wonder the patients refuse not only the galvanic and faradic current, but also every new manner of applying electricity, as Franklinisation, the treatment by light, d'Arsonvalisation, etc. They fear the same disagreeable consequences as from the old methods.

Therefore the busy neurologist and electrotherapist, "*rerum novarum cupidus*," longs for a remedy that shall be a substitute for the electric current and to have in reserve new arts of therapy. The public desires again and again fresh assistance from him, especially by the outward application of these healing factors. The minds of persons who suffer from diseased nerves are often occupied by those injurious doctrines which are propagated in Germany by the "Naturärzte," who preach against the use of medicaments as well as against surgery.

For nearly four years I have used the vibration apparatus "Tremolo" with a regulated action (1900, D. R. P. of the Frankfort Electrotechnic Establish-

ment): Interceder. The Kny Scheerer Co., New York.



VIBRATION APPARATUS "TREMOLLO"
(1/10 actual size)

This apparatus functionates by means of a weight revolving eccentrically and rapidly in a capsule and which is externally fixed to the revolving axle. The motion is communicated from the outside by an electromotor or any other motor through a flexible cross-axle. The capsule G, which is polished and nickled and fixed by a handle of hard India rubber, is globular in shape, about 7 cm. in diameter, and encloses all rotating parts, so that the apparatus can easily be applied to any part of the body, even if the part is covered by clothing.

Exact regulation of the force of the impact is obtained without interruption of the current. For this purpose the ring R, which projects at the far end of the

handle of hard India rubber, can be more or less tightly screwed into the handle. If the ring is screwed tightly to the handle the massaging effects are the strongest whilst by unscrewing the ring they can be modified and diminished to a minimum. For the treatment of different portions of the body special attachments or vibratodes are furnished, which can be screwed into the holes on the ball's surface (Fig. 2).

As regards the regulation of the force of the blow from zero to maximum, the "Tremolo" is distinguished from other rotating massage apparatus, the force being quite independent of the number of revolutions of the motor, and the latter and also the number of the massaging vibrations per minute, whether strong or weak, remaining the same.

About 40-50 revolutions of the motor per second are sufficient to produce all ordinary effects. Regulation of the force of the blow is effected by removing the center of gravity of the eccentrically revolving mass inside the capsule (G) more or less far from the axle of rotation, by reason of which results increase or diminution of the centrifugal force upon which energy of impact depends. But one can also, by simply regulating the pressure on the ball, make the effect more intense or weaker. For exerting the apparatus in places without electricity, a winch impulse transported over a cogged wheel may be used and can be administered by one person for a long time without great fatigue; this motor power produces a very even and efficacious massage.

In looking over my therapeutical experiences I find about 120 cases of functional neuroses that belonged in the great categories of neurasthenia, of hysteria (hyperemesis nervosa), and of hypochondria, but especially distinguished by certain symptoms of depression. Furthermore there were also some cases of sciatica, intercostal neuralgia, neuralgia, lumbago, certain cases of nervous aber-

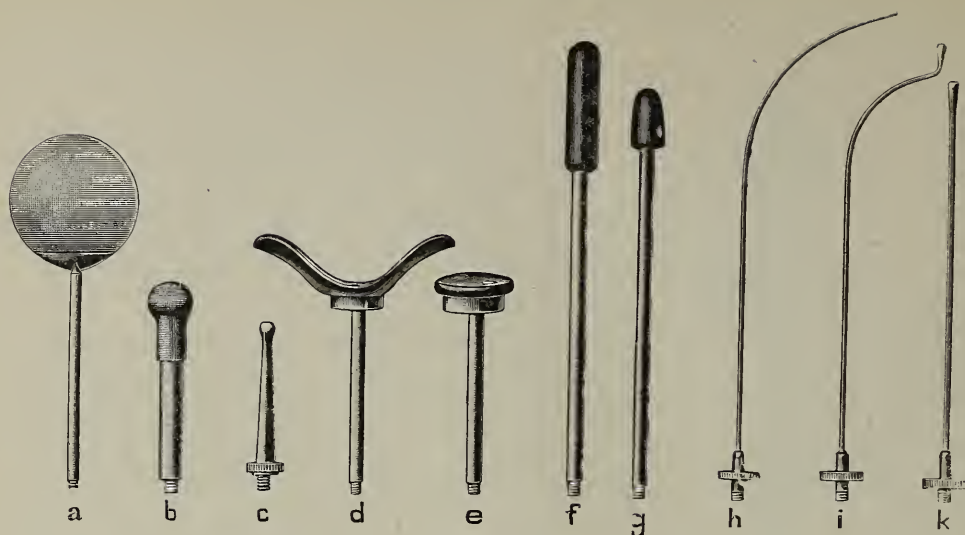


FIGURE 2

ration of the heart action, and some rare cases of paralysis agitans. The patients gave themselves up to my treatment by vibration for some weeks: there were administered 3-4 vibration treatments per week, each lasting from 8 to 10 minutes.

The vibration application with the "Tremolo" may be palliative or curative; its effect may be brought to bear upon the nerve centers or upon their peripheries. In most of the above cases which exhibited *general* disease of the nervous system I let the big ball of the "Tremolo" glide over the backbone, with a slight pressing, up and down and without using any special vibrator, generally following the long muscles of the back on each side, the patient being covered by the chemise or other thin garments. A direct impact upon bones which are covered only by the skin, as the processus spinosi of the tibia or the malleala, is to be avoided; it would be very painful.

In heart troubles I usually apply the ball or the small globular vibrator over the nerves and muscles of the left thoracic wall. Wherever there was a more local disease of the nerves, as hysterical

paralysis of the head or wind-pipe, and neuralgias, I employ the vibrator adapted to the affected region, and treat also the root of the affected nerve if the trouble is neuralgia. I prefer to confine vibratory applications to the body and the extremities, the skull and face ordinarily not bearing the treatment well.

As the handle in which the ring R is to be screwed or unscrewed is marked with a scale from 1-5, indicating the force of the vibration, the intensity most agreeable to the patient is easily ascertained and can be employed in every session.

In cases of chronic constipation or atonic intestines it is recommended to treat the whole abdomen, passing the ball over the abdomen in a circular path following the colon. There is no doubt in my mind that by this manner of vibration a calming effect on the nervous system is gained, a mitigation of local nervous irritations, as well as a good general effect.

The beneficial effect is produced by the mechanical stimulation of nerve organs in the skin, the subcutaneous tissue, and the bones, which, by the use of dif-

ferent technical procedures can be made to extend throughout the whole body; also to the internal organs by way of the reflexes. As the feelings during the vibration following the use of a tuning fork, have lately been made the subject of particular research as regards the sensibility of bones, by Rydel, Seiffer, Goldscheida, Minor, Rumpf, Egger, Dejerne, Trestel, Ehrhardt, Neutra, and others, perhaps the certification of physiological principles involved in vibration therapy will not be long in appearing. In any case vibration has the advantage over faradic treatment that the patient has not to undress himself and that the application of this mechanical stimulant is much less painful for sensitive neurasthenics and hysterics than the corresponding electro-therapeutic modalities.

I have refrained from describing my own experiments conducted by means of the "Tremolo." I know very well that there exist other useful vibration apparatus which have often been described. I have likewise refrained from touching on the literature of vibration for the sake of not exceeding the limits of this short correspondence.

My chief object was to show vibration to be analogous to an older, if not yet complete, method of electrotherapy.

I feel obliged to communicate my experiences with this mode of treatment, my belief that it will be of practical use to our patients, and my recommendation for its trial to all colleagues to whom the variation of these external therapeutic remedies has become a vital question.

If here, as with the electric current, physiology should leave the therapists in the lurch in the near future, it is really not such a great misfortune. "One need not," as I already declared in a little essay on electric baths (D. M. W., 1901, No. 22), "be a friend of suggestive therapy with and without hypnosis and its manipulations. I belong to its opponents because it weakens the will of the nervous patient instead of fortifying it. And though it must be admitted that the physician heals so much better by suggestion, many functional nervous diseases and hypochondriac sensations caused by organic diseases, the more he can avail himself of remedies which take their origin from the modern technic and which follow the modern train of thought, which is always seeking for new and actual effects on the mind, the more influence will he have on the diseased mind of the patient."

Dr. Leopold Laquer.

BOOK REVIEWS

MEDICAL ELECTRICITY. By H. Lewis Jones, M.A., M.D. (H. K. Lewis, London).

This is the fourth edition of a work that deserves to reach the tenth edition. A careful reading of the work has failed to show a single error, but, instead, there is a faculty of clear, concise expression that is very pleasing.

The illustrations, which are plentiful and good, serve to elucidate the text, and have been well selected. The litera-

ture of electrotherapeutics is a well-worn path to the author, and his historical references are of value and interest; thus the use of the brush discharge in 1790 for the treatment of cancer of the breast, and the static induced current in 1791.

The principles of electricity, modes of generation, application, and control are treated with great thoroughness, and the apparatus necessary is described at length. A multitude of points usually found only in works on electrical engi-

neering are met with, each fully and easily explained. The principles and construction of the various meters are illustrated, formulated, and discussed.

The chapter upon static machines reveals the wonderful advance that American ingenuity has made in the construction of such instruments, and one sympathises with those who must use the clumsy and inefficient European models illustrated.

Credit is given to America for the work of Morton, Monell, and others in the development of the various static modalities.

The section on electrotherapeutics is fine, and seems to leave little to add. Electrolysis, cautery, and diagnostic instruments are treated with considerable detail.

The chapter on Roentgen Rays is, as the author states, but an outline, and is the weakest part of the book, simply because this subject does not permit of such great condensation.

The chapter on high frequency will repay careful study by every man who employs high frequency currents.

In every line the author betrays a knowledge of his subject and the ability to convey it to others.

CONSTRUCTION, ERECTION, AND MANAGEMENT OF SPARK-INDUCTORS AND THEIR APPLICATION, WITH SPECIAL CONSIDERATION OF ROENTGEN-RAY TECHNIC. By Ernst Ruhmer. With an Appendix, entitled: A Short Review of the Principles of Roentgen-Ray Technic for Physicians. By Dr. Carl Bruno Schürmayer. Hachmeister & Thal, Leipzig. 1904.

The author has made it a point to be practical and to write in a clear and concise manner. In this effort he has been remarkably successful. As stated in the circular, it is the first large German work on spark-inductors. In this technical guide the practical experience of many years is laid down, so that it may be

highly recommended to anybody who wishes to learn the construction and erection of inductors in an easy and practical manner. Only so much of theoretical deductions is given as is absolutely necessary for the intelligent understanding of the matter.

In the annex Dr. Schürmayer speaks shortly of the Roentgen rays in surgical and medical diagnostics and their therapeutic aspects.

STATIC ELECTRICITY. By Hobard Mason, B. S. E. E. McGraw Publishing Co., N. Y. 150 pp. Price, \$2.00.

This little work treats of the static electricity only, and the author modestly states that there is little original in it, but the subject is certainly handled in an original manner. He has succeeded in making not only a book of references, but one that can be read with absorbing interest.

Practically every proposition in electrostatics is demonstrated mathematically, and even the reader whose mathematics are rusty from neglect will be able to follow the deductions with pleasure if not ease.

The treatment of potential and capacity is excellent. The chapter on instruments is most interesting. The latter half of the work treats upon static generators, and the subject is handled in a masterly manner. A careful perusal of this section will result in the explanation of a great many of the mysterious and irritating maladies from which the average static machine is prone to suffer just when wanted.

On page 141 is noticed the formula for finding the potential in volts necessary to start a spark across any measured gap in air. If the gap length is measured in inches (L), the formula reads, $V = 1,500 + 76,000 L$. In the appendix the different units in use in electricity are defined and stated. On the whole the book is well worth reading, and should then be preserved for reference.

THE ARCHIVES OF
PHYSIOLOGICAL THERAPY

NINE
PLATES

MARCH 1905



SPECIAL PLATE I

BY CARL BECK, M.D., NEW YORK, N. Y.

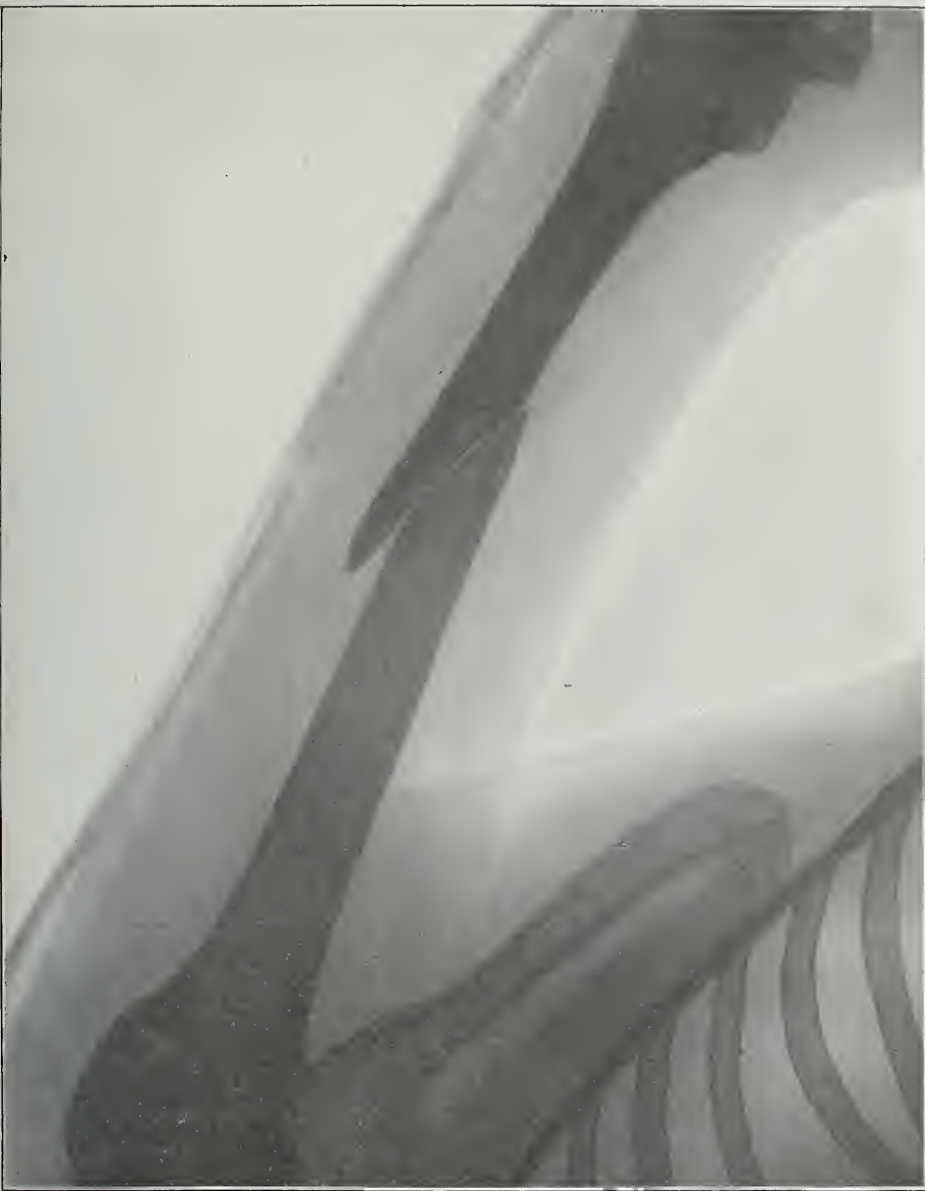
Medullary osteosarcoma of left humerus, ulcerated at the surface — See Skiagraph Special Plate II.



SPECIAL PLATE II

BY CARL BECK, M.D., NEW YORK, N. Y.

Skiagraph of Special Plate I, showing the large osseous center of the tumor as a dense shadow, while the upper and lower portions of the humerus appear more translucent (absorption of calcareous matter) ; compare the normal osseous tissues of the ribs.



SPECIAL PLATE III

BY CARL BECK, M.D., NEW YORK, N. Y.

Oblique (spiral-shaped) fracture of humerus treated by a "collar" splint (plaster-of-Paris).

The splint was applied to the outer surface of the humerus, but has evidently failed to keep the fragments in exact apposition. The skiagraph is another proof of the necessity of using extension during the first few weeks in fractures of this nature. (As a rule counterextension, used while a humero-thoracic plaster-of-Paris dressing is applied, suffices.)



SPECIAL PLATE IV

BY CARL BECK, M.D., NEW YORK, N. Y.

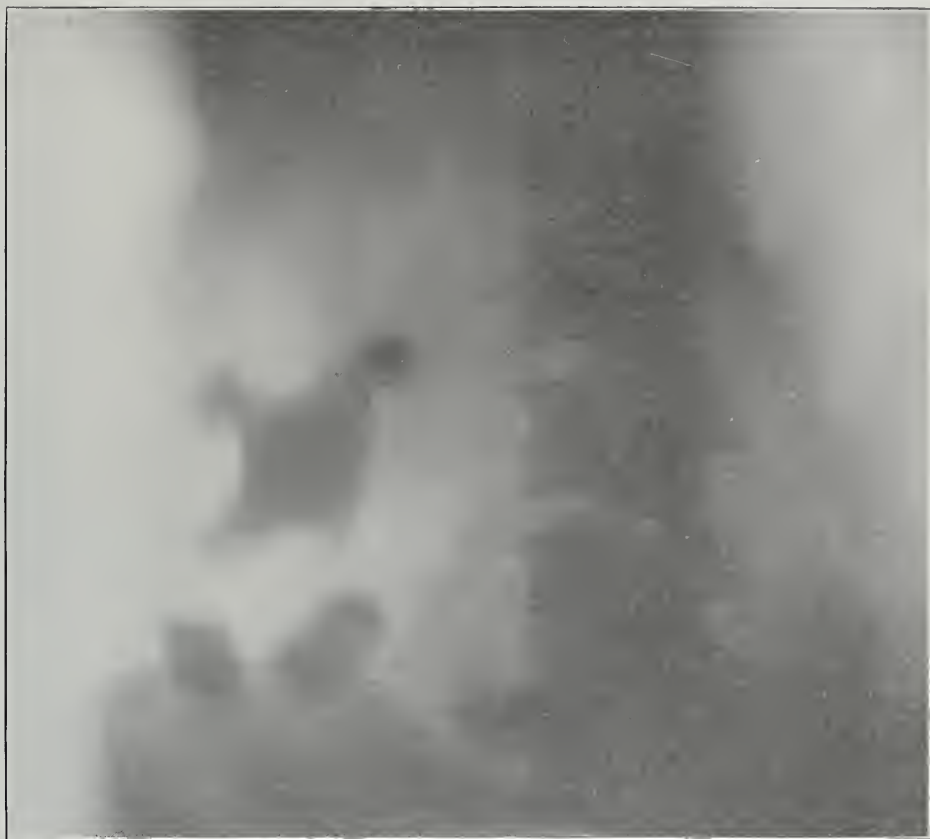
Lower epiphysis of humerus detached and completely turned round, so that it became attached to the diaphysis lengthwise. A big mass was felt at the inner surface of the lower portion of the arm. Those who had no chance to examine the arm skiagraphically thought this mass, which was nothing but the displaced lower end of the humerus, to be abundant callus. The displaced fragment was chiseled away seven months after the injury. (Note the translucency of the fragment, which is caused by inflammatory atrophy. The more marked translucency at the outer surface of the fragment is due to its cartilaginous character, since it represents the articular surface.)



SPECIAL PLATE V

BY GEORGE C. JOHNSTON, M.D., PITTSBURG, PENNSYLVANIA

Stone in the Kidney. Boy, aged 9. Stone unsuspected. Examination made for the location of a stick-pin which the family *had seen him swallow*, but which was afterward found in clothing. Stone removed by operation. Radiogram also shows fecal matter in the rectum. Cramer X-ray Plate. 15 in. Queen coil. Gundelach Tube. 40 sec. exposure. Pyro developer.

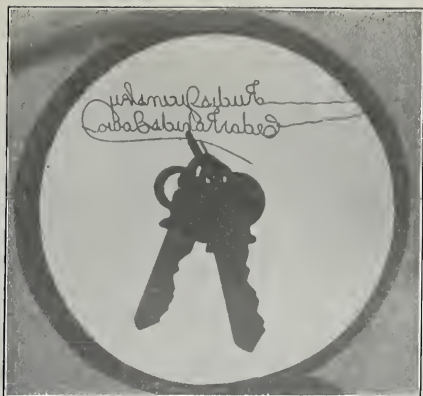


SPECIAL PLATE VI

BY GEORGE C. JOHNSTON, M.D., PITTSBURG, PENNSYLVANIA

Stone and Pus in the Kidney. Large woman. Queen Coil. Queen Tube. Exposure 8 Min. Developer, Pyro. One ounce of Stone and one pint of Pus removed by operation.

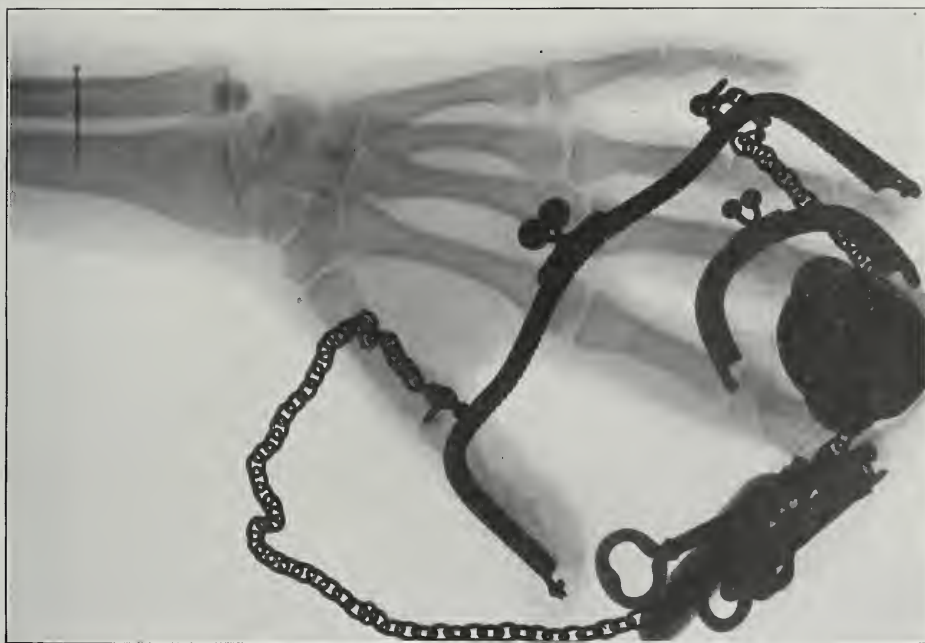
RADIUM IN SURGERY



Two Keys. Picture made with 50 milligrams of radium, 7,000 radioactivity. Tube suspended over a lead plate with opening where the keys were placed on the photographic plate. Time 12 hours.



Photograph through my own emergency satchel. Radium of 300,000 radioactivity. Tube suspended over the satchel for 24 hours.



X-ray Skiagraph of a normal hand made in five seconds, showing the internal structure of the bones. Hand holding a hand-bag with a purse inside containing two dollars, two ten cent pieces, silk handkerchief, a knife and four keys with a few threads of silk, with all the layers of the bag marked. One button laid over the Ulna and a pin in the dress.

The individual muscles of the hand in the negative perfectly clear. Skiagraph made for comparison only.

THE ARCHIVES OF PHYSIOLOGICAL THERAPY

*Devoted to the Diagnostic and Therapeutic Uses of Electricity,
Radiant Energy, Heat, Water, Mechanical Vibration, etc.*

VOLUME ONE

MARCH 1905

NUMBER TWO

RADIO-ACTIVITY

BY A. D. ROCKWELL, A.M., M.D., OF NEW YORK CITY, NEW YORK.

Neurologist and Electro-Therapeutist to the Flushing Hospital, etc.

OUR knowledge of the relations of electricity and matter has received immense accessions in the study of radio-active substances. The study of these substances, in connection with the discharge of electricity through gases, not only strengthens the atomic theory, but indisputably proves that the atom long believed to be the smallest unit of matter is a compound of bodies infinitely more minute.

The investigations of Lenard on the nature of the cathode ray, and the discovery of Roentgen, led to innumerable researches along these lines. Many natural substances were examined, and it was found that some of them were sufficiently radio-active to discharge electrified bodies and to influence photographic plates. The Becquerel rays, evolved from an uranium salt, were the first to be discovered, and subsequently Sir Wm. Crookes discovered that these radiations were due to impurities in the uranium rather than to the uranium itself. According to the theory of spontaneous dis-

integration we here see a veritable transformation of matter, but so slow is the disintegration that it is estimated that thousands of years would elapse before the loss would be sufficient to be detected by any method of precision now at our command.

With radium the case is widely different. With increased radio-activity there is associated a more rapid disintegration, and it is believed that the quantity transformed in a limited space of time is by no means negligible.

The discovery of helium as a product of radium gives strength to the theory of spontaneous disintegration. The next great stride thereafter in our knowledge of radio-activity was the discovery of radium by Madame Curie and her husband, Professor Curie. Her thesis for her doctorate illustrated such an extraordinary grasp of the subject that the Austrian government placed at her disposal a large quantity of the refuse of Bohemian pitchblende from which the uranium had been taken and which was found to be richer in radio-active ele-

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ments than uranium itself. Three elements displaying radio-active properties were discovered, namely, radium, polonium, and actinium, the first of which in the form of radium chloride is found in the greatest quantity and endowed with the highest radio-activity.

The immense labor of its extraction is indicated and its value accounted for when it is understood that but one gramme of radium chloride (pure radium is not yet isolated) can be extracted from eight tons of pitchblende. It is seen therefore that the discovery of radium was no mere accident, but was the result of patient inductive reasoning on the basis of the long recognized phenomenon of radio-activity in connection with some forms of matter, and has resulted in a radical reorganization of scientific hypotheses. The presence of a radio-active element in any mineral can be detected both by the power of the radiations to convert the air into a conductor of electricity or to affect a photographic sensitive plate. As is well known, the gold leaves of an electroscope diverge in an ordinarily dry atmosphere. If any mineral or salt containing an appreciable amount of radium is brought in close proximity, the surrounding air becomes conductive and the leaves collapse. In this way it is possible to test the richness and purity of the radium constituents of any mineral.

The purified radium chloride looks very much like table salt, but is somewhat darker. It evolves heat and in the dark gives off a feeble light, and through certain constant emanations causes phosphorescence in other bodies and especially in sulphide of zinc. The evolution of heat is sufficient to keep a quantity of radium at a temperature of 1.5° centigrade above the normal of surrounding objects. The radiations or emanations of radio-active bodies are not only capable of traversing bodies opaque to ordinary light, and of acting

on the photographic plate, but of powerfully influencing the living tissue in a manner somewhat similar to the X-ray. So powerful and unexpected has been the action of a few sealed milligrammes of the radium salt, carried in the waistcoat pocket, that deep and painful sores have formed, requiring weeks to heal. Like the X-rays the rays of radium cannot pass to any extent through metallic lead, and wrapped in this material the radium salt can be safely carried.

The radiations exercise a very positive effect upon the visual organs by developing a sort of phosphorescence in the liquids of the eye, so that one with the eyes closed experiences the sensation of light. It is very probable, however, that no light is actually seen, any more than that a person really sees the apparent flash of light when the vital function of the retina is called into action by the interrupted galvanic current.

It has been suggested that this influence may be of value in certain cases of cataract, on the following principle: If the retina is organically sound light will be seen under exposure to the radium rays and an operation will be successful. On the other hand, if no light is seen, the retina is diseased and an operation will be useless. Radium is the source of both emanations and radiations, and although the two words are often used indifferently, what they represent are very different in character. The emanation of radium is a gas continually given off. Like other gases it readily diffuses through air and other substances, but cannot pass through glass.

It can be collected in separate receptacles after having been given off by the radium, and in a few days exhibits the properties of helium.

It is not only radio-active, but can impart the same property — only temporarily, however — to bodies in immediate proximity. The radiations or rays are of a complex character. They consist of a variety of physical phenomena,

which Rutherford defined as the alpha, beta and gamma rays. The alpha rays are believed to be electrons, positively electrified and non-deviable by the magnet.

They far outnumber the other radiations, but have little penetrative power and are arrested by glass. The beta rays are also electrons, but unlike the alpha rays carry a negative charge.

They are strongly deviable by the magnet, but in a direction opposite to that of the alpha rays.

They are far outnumbered by the alpha rays, but possess greater powers of penetration. In fact they have many points of similarity with the cathode ray of a Crookes tube. The gamma rays unlike the first two, are not material particles, but consist of undulations of high frequency and exceedingly small wave length. These rays are comparatively few in number, but possess a penetrating power far in excess of that exhibited by their fellows. They are non-deviable and in their actions appear to be very similar to, if not identical with, the X-ray.

What is termed the radio-activity of radium, then, is due to the combined influence of the alpha, beta and gamma rays; the first two being undoubtedly material particles infinitely rapid in their flight, while the last is not material, but a mode of motion. The velocity of the alpha rays is estimated at about 6,000 miles a second; that of the beta rays at 160. It is possible that the distinction between emanation and radiation that has been indicated above may not permanently hold, since the observations of the Curies, Rutherford, Sir Wm. Crookes and others seem to point to the fact that the effects of radium are due simply to the disintegration of the atom.

The spinthariscopes devised by Sir Wm. Crookes is a valuable aid to the study of the properties of radium. It consists of a screen coated with zinc sul-

phide, immediately in front of, and less than the distance of a line from which, is placed a speck of a radium salt. Now if, in a darkened room and with the aid of a magnifying glass, one peers into this little arrangement, he will see a marvelous phenomenon. He will see a brilliant and incessant shower of sparks that proceed from the screen of sulphide of zinc, and the nearer the salt is approached to the screen the more brilliant is the display.

Sir Wm. Crookes holds that in these phenomena we are actually witnessing the bombardment of the screen by the positive atoms hurled off by the radium with a velocity of the order of that of light.

The activities of radium rays and X-rays are in many ways similar. They both have the power of penetrating bodies opaque to any luminous rays hitherto known, and are capable of inducing fluorescence and phosphorescence in the same substances. They both influence the electroscope, and the three manifestations of energy developed in a Crookes tube correspond very closely with the alpha, beta and gamma rays of radium. The well known power of radium to excite fluorescence and phosphorescence in certain other bodies has been followed by statements that by simply immersing a glass tube containing radium in a body of water the water becomes radio-active, and is rendered valuable in the treatment of disease. If true, this assertion might be of the very greatest importance to therapeutics, but unfortunately it seems to be wanting in authoritative confirmation.

Piffard, Abbe, Pegram and others, in thorough experimental tests, have been unable to substantiate these claims. The glass inclosing the radium salt when it is immersed in the water entirely absorbs the alpha radiations, and to a great extent the beta and gamma, rendering the salt quite unequal to an effectual impartation of its radio-activity.

Aluminum has been suggested as a substitute for glass, and on practical test has been found to impair radio-active properties to a considerable less degree. This power of radium to impart radio-activity to other bodies is but temporary so far as those secondary bodies are concerned. After a time, varying with the nature of the body, or whether confined or unconfined, they lose their radio-activity and phosphorescence. As an example, lead rendered radio-active, if immediately put in a glass tube, will retain

its radio-activity a number of days, while if left exposed to the air it loses this property in an hour or so. This condition of radio-activity is seen not only in phosphorescence, but in influencing the photographic plate. Cold, even as intense as liquid hydrogen, fails to influence unfavorably the properties of radium, but a bright red heat seems, temporarily, to exhaust them; a rest of a few days, however, is sufficient for a complete restoration without loss or gain of weight.

THE CATAPHORIC DIFFUSION OF METALLIC IONS IN THE DESTRUCTIVE STERILIZATION OF CANCER AND TUBERCULOUS DEPOSIT *

BY G. BETTON MASSEY, M.D., OF PHILADELPHIA, PENNSYLVANIA.

Attending Surgeon American Oncologic Hospital, Philadelphia.

THE medical world has but slowly realized the full meaning of the modern demonstration of the germ origin of certain diseases. In tuberculosis, cancer and syphilis, for instance, not to mention other analogous affections of less importance, modern research has shown that we have primarily a single nidus of infection, where a germ colony of extraneous origin has succeeded in implanting itself on, or within, the human host, often in a most accessible location for complete eradication, yet the physician is apt to content himself with inadequate methods for its local destruction, relying too much at times on the correlated fact that depressed or disordered vital chemistry has permitted the foothold of the disease to be established, and depending too

much, particularly in tuberculosis, on what might be called physiologic sanitation for a reversal of the soil conditions that permit the continued presence of the disease. Such an attitude is singularly like the old house-to-house sanitation when an epidemic disease has appeared at a port. No one could object to the sanitation, either civic or physiologic, but our modern health authorities now recognize the necessity for a more strenuous treatment of the affected individuals or infected port by isolation and prompt destruction of the imported germs.

We must adopt a similar attitude toward the primal node of infection in an individual in whom a germ colony has become lodged. The knife, necessarily opening the avenues of local and systemic distribution at the cut edges, is often ineffective. Nothing but complete and destructive sterilization of the germ colony in situ, while erecting simultaneously a barrier to the operative dis-

*Read before the *Electro-Therapeutical Section of the International Electrical Congress at St. Louis, Mo., September 12-17, 1904.*

semination of the infected cells, can fulfill the scientific indications of the problem.

An electric modality, the constant current, is herewith called to the attention of the Congress as the most effective agency for conveying germicidal chemicals into and throughout such a germ colony, and clinical details of a large number of cancers so treated will bear me out in the claim that, if the colony is overwhelmed by a sufficient dose dispersed throughout its extent, complete eradication of the infected cells may be secured, with the erection of an effective quarantine of the surrounding tissues.

As the result of many experiments the writer has selected mercury and zinc as the materials which, when ionized and dispersed within the tumor, will best meet the indications. The process may be best understood by a brief narration of the practical details of such an application, taking a major application to a cancer of the breast under an anesthetic, as a sample:

ZINC-MERCURY CATAPHORESIS IN CANCER.

The patient lies on a large dispersing pad, made preferably of clay and as large as the whole dorsal surface. This pad is electrically connected with the negative pole. After anesthesia has been secured, small pointed electrodes of zinc, heavily coated with mercury, are connected with the positive pole and thrust into the peripheries of the growth. The current is now turned on, to a strength, approximately, of 200 milliamperes to the electrode. In a few moments, a whitish area of necrosis will radiate from each point, and from all portions of their contact with the growth, the several areas finally meeting, when the whole growth will become devitalized, softer and inodorous. The devitalization thus produced is so directed from time to time during the application, that the whole base of the

growth, as well as its mass, will be included in this area of complete necrosis and sterilization, its edges subsequently becoming a line of demarcation when the slough separates, some 21 days later. Beyond this area of complete destructive necrosis of all tissues, a zone of infiltration will be found, in which a less dense diffusion has resulted in the death of lowly organized wandering malignant cells without necrosis of the tissues. This surrounding zone of parasitic sterilization will be found to be a most important feature of the practical application of the method, for no other surgical method offers a similar destructive agency against the yet latent migrant cells that surround all actively growing malignant tumors.

The electro-chemistry of this process invites the particular attention of an audience of this character. It is evident that in the electrolysis that occurs in the body electrolyte with a current that sometimes reaches 1,500 or 1,600 milliamperes, maintained an hour or more, large quantities of oxygen, and considerable chlorine, are dissociated, ionized and discharged against the zinc and mercury. The metals thus attacked are eroded deeply, temporary salts form in a dissociated condition, the metallic cations being propelled from the electrodes radially throughout the growth, forming ever changing relationships with the oncoming anions. That these mercury and zinc cations give up their charges as soon as the living tumor tissue is met, in the immediate neighborhood of the electrodes, is evident by their action on the tissue, which turns a grayish-white color. This necrosing action must be that of normal atoms, with full powers of the nascent condition. It is possible that this is so only when the chemicals are developed in considerable mass of concentration.

In practice, it is found that no material amount of these chemicals gain entrance into the body circulation, even

when $1\frac{1}{2}$ amperes (1,500 milliamperes) have been used for three hours in a large growth, the chemicals draining away with the discharges, or remaining within the slough when it separates. Their action at the living tissue edge, when driven in, tends to coagulate the capillaries and lymphatic spaces, forming a barrier against any kind of absorption, whether of germs, cells or chemicals.

The fact that appropriate electrodes, with slender conducting shanks, may be so shaped and insulated as to convey the current harmlessly to the seat of disease, at a distal portion of such body-cavities as the nose, mouth, throat, vagina and rectum, and there develop the cations, indicates a peculiar adaptation of this remedy to germ colonies in these situations.

Such is the major application of zinc-mercury cataphoresis in the treatment of cancer. It is practically a major operation, and will at times cure the disease at once. The minor application varies from this in the absence of general anesthesia, the use of but one active electrode made of thinner zinc, and in the usual necessity for frequent repetition until the growth has been removed piecemeal, if the case is of such moderate malignancy as to permit the minor method to be used successfully. The details of the minor method are somewhat similar to those employed in the treatment of tubercular foci, which will be described next:

ZINC-MERCURY CATAPHORESIS IN TUBERCULAR ADENITIS.

The minor method of zinc-mercury cataphoresis is an office application, employing the constant current of ordinary voltage and the usual dispersing pad. The active electrode is a sliver of zinc, cut from a sheet of zinc, such as can be obtained from stove dealers, a long-handled pair of surgical scissors being usually equal to the task. The sliver is

about $1\frac{1}{2}$ ins. long, and $\frac{1}{8}$ in. wide at the base, tapering to a sharp point, which may be made sharper by a little filing. It is attached to a conductor of slight weight, to prevent being dragged out of position, by twisting the bared end of a sufficient length of No. 32 or 30 copper wire about its base and clamping the base when turned over, tightly on the wire. The electrode is now complete if it is wished to cauterize a tract through the unbroken skin into the tubercular gland; or, if a sinus already exists, the edges of the sinus may be protected and the action confined to the diseased structure beneath, by coating the instrument with fused sealing wax to a point near its tip.

Having placed the patient on a couch with the indifferent negative pad on the abdomen, the electrode is coated with the quicksilver, an opening is made through the skin with a tiny bistoury, or Hagedorn needle, under the chloride of ethyl spray, and the electrode thrust into the opening. A current of from 1 to 3 milliamperes or more is now gradually turned on and maintained for 30 minutes. The burning sensation may be greatly lessened by placing a drop of saturated cocaine solution at the point of entrance of the electrode, the cocaine being diffused locally with the other cations.

A tiny white slough will be found to be the result of the application. It is to be repeated thrice weekly, until the center of the growth is thoroughly sterilized, when the opening is allowed to close, leaving a scar no larger than a pin-head.

This treatment is followed by a complete cure in from six to a dozen applications to each affected gland, and it has been invariably noted that the patient regains a good color during the treatment, followed by subsequent robust health.

ROENTGEN RAY DIAGNOSIS OF CALCULI*

BY RUSSELL H. BOGGS, M.D., OF PITTSBURG, PENNSYLVANIA.

A SCIENTIFIC application of the X-ray in the diagnosis of calculi has shown this method to be far superior to other means of diagnosis. Since the value of this method is so generally recognized in medical science, the question may now be asked, should a surgeon, under any circumstances, ask a patient to submit to an operation for calculi without first having a radiographic examination? According to the judgment of the leading surgeons, every case should be carefully examined by the X-ray, and the radiograph used as a guide for the operation. When such a procedure has been adopted by all surgeons, they will relieve themselves of a great deal of responsibility and the patient, frequently, of submitting to an unnecessary operation. Many times in the past I have heard surgeons not only say that without the X-ray they could not have made a positive diagnosis, but that after the diagnosis had been made they could not have found the calculi in the urinary tract without the radiograph.

It has been said so many times that, unless the radiograph reaches the standard, no diagnosis should be made. But, still, many make a diagnosis from an unsafe negative, and not only bring discredit upon themselves but upon the application of the X-ray as well. It has been agreed upon by a large number of operators that a plate, in order to make

a positive diagnosis of a kidney-stone, should show every articulation, the spinous and transverse processes of the vertebræ, the outline of the last two ribs and the psoas muscles. A radiograph showing a gall-stone should show the outline and detail of the ribs, vertebræ, upper border of the liver and division of the bronchial tubes; and a radiograph to show a stone in the bladder, should show all details in the bony structure of the pelvis.

The amount of knowledge gained from examining a radiograph depends entirely upon the experience of the operator. Too much stress cannot be laid upon the interpretation of the negative, otherwise small calculi composed of uric acid may be overlooked. Great care should be taken in making these radiographs, otherwise an imperfection in the plate might be mistaken for a calculus. This shows the necessity of taking two radiographs before making a positive diagnosis. The laity may be glad that nearly all the hospitals have realized that it requires more knowledge of medicine and electricity than the head nurse or some other inexperienced party knows to make a careful diagnosis of calculi.

In my experience I have seen radiographs which did not come up to the standard, and a negative diagnosis had been made. In one of these cases, the surgeon was very positive, from the patient's symptoms, that there was a stone in the urinary tract, but was undecided whether it was in the kidney or ureter. He sent the patient to my office for an examination. Two radiographs were taken, in the usual way, by placing one plate upon the other, and both negatives showed a stone in the pelvis of the kid-

*Read at the joint session of the American Electro-Therapeutic Association and the Electro-Therapeutical Section of the International Electrical Congress at St. Louis, Mo., September 15, 1904, and published in this journal by special permission of the author and the Executive Council of the Association.

ney. On the other hand, many of you have seen a positive diagnosis made from a poor negative, and, of course, after the operation the surgeon and assistants had a very inferior idea of the X-ray. The radiograph should be up to the standard, and then if the surgeon does not find the calculus, we can say it was due to lack of skill on his part and not the fault of the X-ray.

The difficulties in radiographing calculi are numerous, and practice is the only means by which this class of work can be done successfully. Many are continually asking, what exposure do you give, whose tubes and plates do you use, etc.? This all means very little. Every part of the work should be done in an accurate way, and a perfect radiograph will be produced.

An English writer states: "Personally, I know of no application of science in which the personal equation plays a more important part than in the application of the X-ray in medicine and surgery, and it, therefore, follows that it is exceedingly difficult to lay down fixed rules."

You can produce good radiographs by using any make of tube, if properly constructed, any make of plate, and almost any length of exposure. The exposure varies with the apparatus, size of the patient, and may range any place from 5 seconds to 10 minutes. I prefer to make a short exposure, and if the patient does not weigh over 150 pounds, usually I give from 15 to 30 seconds. By so doing, the patient can hold his breath and there is no movement of the kidney and the image is more distinct. How much the kidney moves during respiration is a question, but there is a certain amount of movement.

I will mention an instance where a uric acid calculus, scarcely discernible on the plate when an exposure of two minutes was given, was seen more distinctly when I had made a second plate in 30 seconds while the patient was hold-

ing his breath. Both radiographs showed the psoas muscle, but the stone was in the upper portion of the left kidney and partly obscured by the stomach. I believe the motion by respiration made the difference.

It has been well demonstrated that, with almost any induction coil good work can be done, providing the technic is nearly perfect. However, variable inductance in the primary is of a decided advantage. There is a greater difference in the X-ray tube than any other part of the apparatus, and the variable inductance is an advantage when working with low tubes.

You will find tubes made by the same manufacturers, one with which radiographs can be made very quickly, while with another tube which appears to be identical, you will not be able to produce results no matter how long an exposure is given. I have purchased a number of tubes and have learned that the tube was largely accountable for successful or unsuccessful work, both in radiography and radiotherapy, and the sooner the profession will learn that many of the failures are due to faulty tubes, the sooner the X-ray will attain its proper standing.

In radiography, I have always attempted to secure a tube which is focused to a point on the anode, which, when the internal resistance is low, will give sufficient penetration. I have usually found, when the light will penetrate the chest and show the bones very dark on the screen and the internal resistance of the tube is less than 2 ins., i. e., if it will not back a parallel spark of more than 2 ins., it may be considered a valuable tube. According to Ohm's law, the less resistance of the tube, the more current you can pass through it, and the more work will be done in a given time. In a high-vacuum tube, a larger amount of current is used to overcome the resistance. Then again, many use a tube which has too great penetration either to secure the best results or to do the

work in the shortest time. It is only the rays that remain in the plate which are active.

The diagnosis of gall-stones by the X-ray has been accomplished by a number of physicians, and so far, I believe, no one claims to make a negative diagnosis, i. e., if the radiograph does not show a gall-stone the operator would not be positive that a stone was not present; while if the radiograph, made properly, shows a shadow, you can safely make a diagnosis of gall-stones. The reason why all gall-stones cannot be located by the X-ray is on account of the composition of certain stones.

In Thompson's "Practice of Medicine," there is the following classification according to the chemical composition:

1. Chiefly cholesterin.
2. Bile—Pigment and calcium.
3. Calcium carbonate and phosphate.

"Every gall-stone, like a vesical calculus, is found to have a nucleus of such material as bilirubin, calcium salts, or, exceptionally, a foreign body or micro-organisms. Around the nucleus the cholesterin is deposited in layers, which are both concentric and radiating. The external laminæ are brown, relatively hard, and composed in greater part of calcium salts. In addition to the above fatty and bile acids, magnesium, iron and copper are found."

When calculi are composed almost of pure cholesterin, they cannot be located by the X-ray, but if they contain sufficient mineral substances, the stones can be detected. At present, it cannot be stated what percentage of gall-stones can be located by the X-ray.

The only point in connection with the technic of making radiographs of biliary calculi I want to mention, is that the exposure should not exceed 30 seconds, while the patient holds his breath and then there will not be any movement of the calculi.

While it has been shown that a nega-

tive diagnosis in a case of suspected gall-stone is not always correct with a radiograph which has reached the standard, it is safe to make both a positive and a negative diagnosis of the stone in the urinary tract, providing the radiograph shows sufficient detail.

I have no cases of unusual interest of stone in the pelvis or substance of kidney which have never been reported, but I have located stones in eight cases in the ureter at its junction with the bladder. In two of these cases there was a stone on both sides in the same location, at the junction of the ureter and the bladder.

Five of these cases were referred by Dr. Buchanan, and, after the radiographs were taken and an examination was made through the rectum, in two of these cases the calculus could be felt very easily, and in one case, when the calculus was touched, the patient had pain in the region of the kidney. The history of this is so interesting that I shall report part of it.

Case 1.—Mr. B. had been troubled with pain in his right side for some time, and during one of these attacks, while in Philadelphia, called on a very prominent diagnostician and a noted surgeon, who made a diagnosis of appendicitis, and told him that he must have his appendix removed within 24 hours. Fortunately, the patient refused to have this done, as there was certainly no appendicitis.

Case 2.—Mr. G., age 25 years, had suffered with abdominal pain for more than two years. When in New York 12 months before coming for the X-ray examination, he had been operated upon for appendicitis. The patient most likely never had appendicitis, as the symptoms could have been all accounted for by renal colic.

Two radiographs were taken, one with a 15 and another with a 30-second exposure. Both plates were good and showed a stone in the left ureter, but the

short exposure was the better. The patient weighed 145 pounds. He went to the hospital and Dr. Buchanan operated before the class of the West Penn Medical College.

The calculus was found in the first portion of the ureter. The patient made a good recovery and had hardly left the hospital when he had an attack of colic on the right side. Upon careful examination, the first radiograph showed a stone in the right ureter at its junction with the bladder. The patient went to Cambridge Springs and while there passed a calculus. Afterward, he returned to the Mercy Hospital and had the right kidney operated upon and a large amount of pus was found, following which he recovered. Another radiograph was subsequently taken which showed two small stones in the ureter at the junction of the bladder. These have not been removed, but the symptoms indicate that he will be compelled to undergo another operation.

Many surgeons have said it was unnecessary to make a radiograph to diagnose vesical calculi, as they are so easily discovered by the sound. I have observed several cases in the past year in which the X-ray proved superior to the sound, not only in making a positive diagnosis, but also in showing the number, size and shape of the calculi. Then

the surgeon is better able to decide which operation is indicated. It has often been said that there is considerable difficulty in radiographing small stones in the bladder on account of the bony structure of the pelvis, but so far, I have not found this to be the case, and in no instance have I failed to find a calculus where it was detected by the sound, and I have found stones which could not be located by the surgeon. A calculus of pin-point size in the bladder should be located by the X-ray.

In conclusion, therefore, no operation for calculi in the urinary tract should be undertaken without first having verified the diagnosis by an X-ray examination, but this examination must be conducted on as concise methods as the surgeon in removing the stone, with particular attention to technic, in order that the plate will always reach the necessary standard. After the plate has been made, it is essential that it is correctly interpreted. Two cases reported showed instances where a stone in the ureter had been diagnosed for appendicitis, and one had been operated upon.

It is a question whether the X-ray at the present time is of special advantage in the diagnosis of gall-stones, since a portion contain pure cholesterin which will not cast a shadow.

RADIUM IN SURGERY*

BY J. RUDIS-JICINSKY, A.M., M.D., M.E., CEDAR RAPIDS, IOWA.

THE basis of this paper consists of my own original observation, experimentation, and research. I am far from thinking lightly of the labors of others in this new field, but still it is true that, respecting

very many of the facts that have come under my notice in skiagraphy and radiotherapy, I have encountered, in endeavoring to reproduce and verify published statements, so much perplexity and difficulty that I was ultimately thrown back upon myself and my own study; compelled to observe *de novo* and to set down simply what I have seen,

*Read before the Iowa Medical Union, Cedar Rapids, Ia., December 13, 1904.

observed, and could record as facts myself. Having come to a knowledge of the existence of matter in an ultra-gaseous state and of material particles smaller than atoms; of the existence of electrical atoms or electrons; the constitution of Roentgen rays, their behavior in skiagraphy and radiotherapy of the cathode rays and ultra-violet rays and the reciprocal relations of these various rays in the constitution of light proper in the spectrum; the passage of the X-rays and similar rays through opaque bodies; of the emanations from uranium and thorium; the continuously-emitted radiations of three varieties from radium, a new elementary substance found in Bohemian pitchblende by the Curies of Paris; and of the phenomenon of dissociation of elements, we are now prepared to use radium bromide or chloride of high radio-activity for the treatment of some inoperable cases of carcinoma, epithelioma in cavities, and more superficial lesions like lupus.

Apart from heat rays three distinct kinds of radiations are constantly evolved from radium which have been named alpha, beta, and gamma rays; the gamma rays, being analogous to X-rays, pass through many substances opaque to ordinary light, and produce acute dermatitis or necrobiosis on prolonged exposure even in healthy tissues, the lesions exhibiting all the different stages of erythema, etc.

To call the energy in these rays "life-giving" would be an error. In my opinion at least they are death-producing toward all living cells, either animal or vegetable, the degree of such effect being proportional to the dosage administered, absorption secured, and the time of exposure thereto. The value in medicine and surgery of these and similar radiations must rest solely upon the hope that the energy given out by the so-called radium may destroy the life of the less resistant cells of diseased tissues and germs, before destroying the healthy

cells of the body, thus leaving these latter free to recover themselves. We have made experiments showing that radium retarded certain growths of bacteria, and when introduced under the skin of a guinea-pig or a mouse, along the spine, it either killed them in a few days or complete paralysis followed, proving beyond doubt that the gamma rays had the same effect on nerves as the X-rays, as I have had the honor to demonstrate to you before. They act upon the photographic plate like those from uranium, thorium, zirconium, polonium, and other rays of this order, but will not produce such skiagraphic results as will the X-rays because they penetrate the bones quite as easily as they do the flesh, and it requires at least 24 hours, using a radium of high activity, to obtain an outline of the bones in the hand for instance; during that time we may produce an intense irritation of the exposed area of tissue. With the X-ray, on the other hand, we can get a beautiful picture of the human hand in few seconds, with all the details of the bones, soft tissues, etc.

The beta rays are rather less penetrating than the gamma rays but have many other properties, notably that of carrying negative electric charges, and are exactly similar to the cathode rays of the Crookes tube. These charged particles have been named electrons, and may have an effect on those lesions which are superficial (on the skin), new growths which are not deep affecting accessible mucous membrane, or those which do not prove susceptible to the influence of the X-rays; they act more promptly but can not be applied over so large a surface at one time as the Roentgen rays.

The alpha rays have exceedingly slight penetrating power and carry positive electric charges, being particles shot off from the radium atoms with enormous velocity, as you may observe in the spinthariscopes where a very small quantity of radium is suspended over a

screen, coated with a material which is rendered luminous by the impact of the particles. Upon viewing this through a magnifying glass the never-ceasing and beautiful effect of the radiations is clearly visible.

In the treatment with radium we depend most on the beta rays and apply them especially in those cases where the X-rays fail, because the radiations from radium salts, unlike those from the X-ray tube, are uniform, and with a proper degree of radio-activity, when care is exercised to avoid "burns," we may heal some cases wherein the lesions are not deeper than about half an inch and little infiltration is present. For safely handling radium and for applying it to the skin and cavities of the body, we use special attachments, consisting of a radium box with an aluminum shield, lead-lined box for the same, lead shield and handle to throw the rays straight and protect the surrounding tissues; a bulb for use in cavities, to ray at right angles when necessary; and another for direct application. Radium salts of an activity of 7,000 or considerably more, are not sufficiently strong to be efficient unless the amount of the salt is large; therefore we recommend such radium as being less likely to produce excessive irritation or "burning"; by the use of large quantities (at least fifty milligrams), the therapeutic effects are perhaps as satisfactory as with a smaller amount of radium of 300,000 activity.

But now for the main part, the dosage in the treatment with radium, and here we are!

To report a case and a cure of a certain lesion with radium, would have about the same value as to report that a certain lesion has yielded to the knife. Such statements do not mean very much, being about as worthless as the reports with half-tone illustrations of patients treated by X-rays, before and after treatments, when the technique employed, the nature of the tube used, the time of

exposure, the distance of the tube from the lesion proper, the make of the tube, and the field of the best rays in the same with other peculiarities of the tube, pathological features of the given case, etc., are not given. The degree of radio-activity, quality and quantity of the X-rays produced, probable degree of absorption of the rays by the tissues, differ radically in different cases.

Before we use any new remedy or any new drug we simply put it under careful observation, and do not depend upon the statements of the most reliable manufacturer or his testimonials from even the best circles of our profession; we do that with the most harmless composition. With radium, the pathogenic effects of which may do more harm than good in some cases, we simply apply it in the hope of getting good results, without knowing what we are doing, without knowing the dosage which the patient is receiving of certain radiations which are powerful and capable of exercising destructive effect upon tissues of low vitality, and, if the exposures are injudiciously prolonged, also of injuring the normal tissues. In the early days of X-ray therapy, when there was no instrument like an ammeter with which we could measure accurately the current actuating our tube, it was impossible to find out exactly the dose of the radiations applied or the energy of the electro-chemical action necessary to produce results. With radium the difficulty is still greater, because we have to depend entirely upon the statement of the manufacturer, who will sell you fifty milligrams of radium of 7,000 radio-activity just as readily as one of 10,000 or 300,000, according to whatever preparation exerting radiant energy he may have in stock. Naked radium affects the photographic film as we know, it also affects to some extent the electroscope, and to a somewhat greater extent the electrometer; but radium covered with glass, aluminum, celluloid, mica, etc., will not

and cannot exhibit the same efficiency as when it is uncovered, and this fact must be taken into consideration in connection with every case to be treated.

Now, if we take for granted that the preparation which we bought for radium of 7,000 radio-activity, and if our electrometer confirms the maker's statement as regards strength, we have yet to be assured that the radiations which affect the photographic film in a certain degree are the same which affect the electrometer by ionizing the air in that apparatus. If they are not the same, which of the radiations are affecting the human tissues during our treatment? All of them, we may say, just as with the radiations from the anode of a Crookes tube, but with the latter apparatus we may control and measure the quantity of the rays of the X-ray order, exclude certain rays if we desire, protect our patients if necessary, and be guided as to the adoption of these various procedures by observing carefully the behavior of our tube and apparatus. With radium we simply cannot do this. We know that we are dealing here with three distinct kinds of radiations, some of which, called gamma, are of a character similar to X-rays; we know that we get a considerable amount of heat; that the radiations are evolved continuously, apparently without change in the material constituting their source (although there is a transformation into some other

form of matter, as Sir William Ramsay states); but that is about all we do know or have ascertained during the lapse of a year or more. All other sensational discoveries (?), etc., are theories upon theories of very little practical value for us.

For my part I have not seen much benefit from radium treatment, as yet, except perhaps the occasional analgesic action of the radium emanations in some individual cases; the production of some irritation in superficial lesions whereto they have been applied in the hope of modifying carcinomatous and lupoid processes; some temporary hyperæmia in the healthy skin around lesions treated; and necrobiosis of the same character as that exhibited by the so-called X-ray "burn," which has followed, in some instances, prolonged exposures to radium radiations. Only one case of lupus has seemed to yield better to radium than to X-rays, one case of epithelioma of the upper lip, and one case of superficial carcinoma of the breast; other cases presented absolute failure and we had to return as soon as possible to the X-ray treatment.

What the near future may bring, or has in store for us as regards the peculiar radiations from radium, we do not know and cannot know, until experience and critical experimentation have given us a reliable basis of facts upon which to erect our conclusions.

THE X-RAY IN TUBERCULAR ADENITIS*

BY MAY CUSHMAN RICE, M.D., OF CHICAGO, ILLINOIS.

Professor of Clinical Electro-Therapy at the Illinois School of Electro-Therapeutics, etc.

NO subject is of greater interest to the medical profession today than that of tuberculosis. Not only has it been one of the leading topics for discussion (at the meetings

of the various medical associations all over the world during the past few

*Read at the Fifth Annual Meeting of the American Roentgen Ray Society at St. Louis, Mo., September 9-13, 1904.

years), but special conventions have been held for the consideration of this subject. These congresses are largely responsible for the growing interest in this dread disease, and for the multiplied efforts to prevent as well as to cure it. That drugs are of little value in tuberculosis is generally admitted, cod-liver oil and creosote having given way to diet, hygiene and climate. The various antitoxic and anti-bactericidal serums discovered have been tested and generally discarded. The surgeon has even attempted to eradicate the disease with the knife. Yet tubercular patients, either under intelligent or oftentimes misguided advice, are migrating to better climates in the vain search for health.

In spite of all this it is generally conceded that tuberculosis can be arrested, sometimes by one method, sometimes by another, but in any instance it must be by increasing the natural resisting powers of the tissues. As a means toward this end the interest, of the medical world, especially the electro-therapeutical, centers itself now about the various forms of light, such as the Finsen and the X-ray, as a cure for tuberculosis.

One rarely takes up any of the leading medical journals without seeing some reference made to cases of this kind treated by the X-ray. Some reports, seemingly authentic, have been made of symptomatic cures of incipient pulmonary tuberculosis by this means. The question arises, will this comparatively new agent share the fate of other previously supposed remedial measures as a cure for pulmonary tuberculosis; or will it, further developed and better understood, accomplish for the deeper structures what is already assured for the more superficial?

As yet in tuberculosis, as in cancer, the value of the ray is in direct proportion to the depth of the lesions, the best results so far having been obtained in cases involving the skin. However, the writer has had most encouraging results

in tubercular adenitis. While high-frequency currents have been somewhat successful in several cases, the results have not compared favorably with those obtained by the X-ray.

A young girl of eighteen years presented herself for treatment with the following history: She had had five operations, involving the entire length of the right side of the neck, the supra and infra-clavicular regions and the axillary as well. The diagnosis of tubercular adenitis had been made by microscopical examination at the time of operation at the post-graduate medical school. The glands of the left side of the neck had now become extensively involved. The uppermost one, near the ear, was as large as a guinea egg, and all of the signs of inflammation were present. It was extremely tender upon pressure and painful. At the middle of the neck was another gland, a little smaller, as well as other smaller glands also apparently about to break down. Her temperature was 100° F., pulse 112. X-ray treatments were given ten minutes three times a week with a medium vacuum tube; tube distance three inches. After the third treatment the tenderness was entirely gone. The glands steadily decreased in size until at the end of two months the largest gland was about the size of a bean. There was corresponding gain in weight and in general health. The contrast between the two sides of the neck, the one surgically treated, a mass of scar tissue, the other free from scars, speaks for itself in favor of the X-ray.

The only other case of tubercular adenitis which I shall report in full is one in which the glands of large size had not shown any signs of breaking down. The diagnosis in this case was made by the clinical symptoms and the family history.

Miss C —, age 32; mother and sister had both had enlarged glands, suppuration having occurred in the case of the

mother. The patient had a chain of glands extending from the ear to the clavicle; the largest one, situated below the ear, was as large as a hen's egg. These glands had been somewhat enlarged for five years, but had been growing rapidly during the past four months. The patient had been taking iodides for some time. After three months of treatment with the high-frequency current by means of the Tesla coil and static machine, with only slight improvement, the X-ray was substituted, after which the patient improved. She has now been under treatment five months, when the glands can scarcely be felt.

Occasionally the physician is cheered by an encouraging result in cases where the lesions are deeply seated, and led to be hopeful that the X-ray will yet prove the remedial agent for pulmonary tuberculosis. This is well illustrated by the following case, referred to my clinic in the Illinois School of Electro-Therapeutics, a previous diagnosis of tuberculosis of the peritoneum having been made. Eva H——, colored, age 11; mother died of pulmonary tuberculosis and her step-mother died of the same disease. The child has never been well; was a bottle-fed infant. When five years of age she set fire to herself with matches, and was badly burned over the groin and pubes and somewhat on the face; was in the hospital seven months for skin grafting. About the first of March, 1903, she began to have fever and to complain of not feeling well. She had a slight diarrhoea and a capricious appetite, but no pain. Physical examination revealed marked distension of the abdomen, the latter of doughy consistency, and a large amount of fluid in the abdominal cavity. Temperature 101° F., pulse 140. Beginning April 25, the X-ray was used with high vacuum tube three times a week. There was gradual improvement, as shown by the pulse and temperature. May 28, temp. 99 $\frac{3}{5}$ ° F., pulse 112; June 30, temp. 99 $\frac{3}{5}$ ° F.,

pulse 110; July 30, pulse 100, temperature normal. October 31, the history reads: "Temperature has been normal for two weeks, the pulse ranging from 92 to 98. The fluid has entirely disappeared from the abdominal cavity. From October 14 to the present time the child has been in school, coming only once a week for treatment. She is apparently perfectly well, although there is an occasional slight rise of temperature and the pulse ranges from 90 to 100."

The two cases of tubercular adenitis reported above are illustrations of a number of others, of whom one was treated two years ago, symptomatically cured, with no recurrence. One was discharged cured two months ago, and five are still under treatment, having been treated from one to five months. Two of these will be discharged soon. Four cases have had operations on other glands previous to X-ray treatment, the diagnosis having been made at the time of operation. In one case the gland treated had been lanced three months before beginning treatment.

In one case, inflammation having been present previous to treatment, the gland suppurated and was lanced after the fourth exposure, and treatment continued. In all of the cases except two a family history of tuberculosis was obtained. In one of these two the diagnosis was made by microscopical examination. The patients are all females, their ages ranging from 8 to 40 years. No case was complicated by pulmonary tuberculosis. The cases were all treated three times a week, the time of exposure being from eight to ten minutes. The tubes were of medium vacuum, the tube distance ranging from three to six inches. Leadfoil was used, the face only being covered. In no case has there been a dermatitis beyond that of an erythema or tanning, and it has never been necessary to omit more than one or two treatments for this to subside. Constitu-

tional treatment was given where indicated, not differing, however, from that used before the X-ray was begun.

In regard to recurrence, the writer can only say that in her experience in other classes of cases symptomatically cured by the X-ray there has as yet been but one recurrence, that being in a ro-

dent ulcer, which healed after only five treatments.

The absence of any considerable reaction in these cases would favor the supposition that the results were due to the stimulating effects of the rays, causing local resistance and improved nutrition, rather than to a directly destructive action upon the tubercle bacillus.

EDITORIAL

AN ADDITIONAL SECTION IN THE AMERICAN MEDICAL ASSOCIATION

At the last annual meeting of the American Electro-Therapeutic Association held in St. Louis last September, it was voted, on motion of Dr. G. B. Massey, to request the American Medical Association to form a section on Electro-Therapeutics, and this request was forwarded to the proper officers.

This is a step in the right direction, but it does not go far enough. Let us by all means have a section which shall include electro-therapeutics, but let it at the same time include all the other methods of physiological therapy and call it the Section on Physiological Therapeutics.

The first thought that suggests itself in connection with such a proposition is that the section on Pharmacology is intended to include therapeutics, and that remedial measures of all sorts should be treated therein. While this constitutes a valid objection, theoretically, to the formation of an additional section, and while it is of course desirable to have as small a number of sections as possible, yet practically it is found that the number of important papers dealing exclusively with drug therapy, fills this section to overflowing every year and there is no room on the programme for papers

on the physiological methods; although many are offered, few, as a rule, can be chosen.

That such a section is now needed is evidenced by the large and increasing number of papers upon these modalities that appear in the proceedings of the general and special societies, and in the various medical periodicals; by the dissatisfaction of many reliable authors who have offered valuable, important, and interesting papers upon these subjects to the section on pharmacology during late years and have had them rejected for "lack of room"; and by the great number of physicians who are using the various forms of physiological therapy today.

That these methods exhibit valuable remedial properties and have attained therapeutical standing is unquestioned; it only remains to provide for their rational, scientific, and ethical investigation and development, and surely no conditions could be more favorable for the attainment of these objects than those which would obtain if such investigation and development were to take place within the precincts of the American Medical Association.

Every American physician today regards his national medical association as his highest court of authority, and he has a right to expect that it will actively support all efforts to direct the search-

light of truth upon questions likely to be of moment in the management of disease, and that its proceedings will keep him informed in reference thereto. No medium could be more efficacious through which to disseminate knowledge and detect error than this same body, and there is much valuable knowledge to be disseminated and much error to be detected and eliminated in connection with physiological therapy.

It is sincerely hoped by a large and interested proportion of the members of the American Medical Association, that the spirit evidenced by the official and public request of the American Electro-Therapeutic Association will receive the consideration it merits, and that this consideration will lead, at Portland, to the institution of a section on Physiological Therapeutics, so urgently needed, obviously desired, and earnestly requested.

THE ROENTGEN CONGRESS IN BERLIN

In order to suitably commemorate the tenth birthday of Professor Roentgen's great discovery, the Berlin Roentgen Society has arranged an elaborate congress to be held in Berlin from April 30 to May 3, 1905. An extensive and interesting programme of papers is being prepared in connection with which there will be an exhaustive exhibit of X-ray apparatus. It is intended to have not only the present status of the X-ray as a diagnostic and therapeutic agent expounded and illustrated, but also the different steps of its development in the different fields of medical practice.

To better facilitate such illustration the exhibit will be divided into two portions, a medical section and a physico-technical section.

In the medical section will be exhibited skiagraphs, both ordinary and stereoscopic, macro- and microscopic specimens from the different fields of medicine,

surgery, dentistry, and veterinary surgery, which demonstrate directions in which the X-ray is of value in these fields; in short, anything illustrating the use of this agent in diagnosis or therapy.

The physico-technical section will deal with all kinds of instrumental equipment which are of use in Roentgography, including the literature and different special periodicals which deal with the subject published throughout the world. It is intended to have every phase and instrumental accessory of the subject treated thoroughly, so that one may have a complete, exhaustive view of the development of the X-ray from the time of its discovery by Professor Roentgen to the present.

For those who desire to exhibit apparatus a current of from 110 to 120 volts is provided. The space rent will be \$2.50 for each square yard. All express matter should be sent to "Herr Speditur Knauer, Berlin, Wichmannstr. 5, Germany." All applications for space or communications in reference thereto should be sent in before March 15, 1905.

The membership fee is fifteen marks (\$3.60) and all applications for membership should be sent to Dr. Immelmann, Lutzowstrasse, 72, Berlin, W.; also all notices of papers or dissertations which members may desire to present for the programme. Cards of membership will be sent out from the Bureau of the Congress on and after April 27th, all money orders for which should be sent to Dr. Cowl, Berlin W., Gleditschstr. No. 6.

Circulars concerning Congress and exhibition, giving explicit directions regarding all questions of transportation, insurance of exhibited instruments, amount of duty to be paid on transported articles and apparatus, expressage, etc., will be sent upon application to either of the above-named officers. The guest of honor of the Congress will, of course, be Professor Roentgen and the Honorary Chairman is Professor von Bergmann.

The titles of the various papers which will be read have not yet been placed at the command of the committees, but amongst those who will read are Professors Ewald, Heubner, Hoffa, Israel, Kohlrausch, Koerte, Kraus, Lassar, Lesser, von Leyden, Schaper, Waldeyer, von Mickulicz-Radecki, and Kroenlein.

The distribution of the general programme as determined to date is as follows:

Sunday, April 20th.

12 M. Inauguration of the Congress and of the Exhibition.

Monday, May 1st.

9 A. M. Physico-technical Meeting.

3 P. M. Meeting of sections.

8 P. M. Dinner.

Tuesday, May 2d.

9 A. M. Medical Meeting.

3 P. M. Meeting of sections.

9 P. M. Exhibition of plates with stereopticon.

Wednesday, May 3d.

9 A. M. Meeting of sections.

3 P. M. Meeting of sections.

The Executive Committee of the Congress and Exhibition is composed of Dr. Eberlein, Chairman; Dr. Immelmann, Secretary; and Dr. Cowl, Treasurer.

The Congress will be held in the halls of the "Ressource," Oranienburger-Strasse 18 (at the Monbijouplatz), and a most cordial invitation is extended to foreign X-ray workers to become members, to be present, and to present papers. There is little doubt that this event will have a greater influence in disseminating knowledge of the Roentgen ray, and will give those who attend a greater opportunity of acquiring such knowledge than any event which has taken place since Professor Roentgen discovered it.

CURRENT PHYSIOLOGICAL THERAPY

JOURNAL OF ADVANCED THERAPEUTICS

New York, N. Y., February, 1905.

1. Dupuytren's Contraction, with Indications as to Treatment — Wm. J. Herdman.
2. Phototherapy in Chronic Diseases — J. H. Kellogg.
3. Radiography — Herman Grad.

1. See THE ARCHIVES for February.
 2. See THE ARCHIVES for February.
 3. Advanced sheets of the chapters on radiography and radiotherapy to appear in "Conservative Gynaecology," by G. Betton Massey, now in process of publication by the F. A. Davis Co.

The accepted facts regarding the therapeutic use of the X-ray, especially in malignant disease, are set forth and

discussed. Grad considers that this agent is not as efficacious in the treatment of deeply-located growths as in those occurring in the integument, but that even if it did nothing but cure rodent ulcer and some epitheliomas it would be entitled to a place in the foremost ranks of therapeutic remedies. He is in favor of removing the mass of deeply-located cancer surgically and then raying afterwards. The osseous structures and large blood-vessels are considered to prevent the rays from reaching mediastinal malignant tumors in sufficient intensity to produce much curative effect.

With a view to avoiding dermatitis, to which he considers some persons more susceptible than others, it is recommended that until such susceptibility is eliminated the exposure should be short, two minutes where a coil actuates the tube and ten minutes if a static machine

is used. These applications should be repeated every other day for a few treatments and then an interval of four or five days should supervene in order that the dermatitis may be given an opportunity to develop if such development is imminent. If no susceptibility is exhibited the exposures may be prolonged, but the utmost vigilance should constantly and invariably be exercised.

ARCHIVES OF THE ROENTGEN RAY

London, England, February, 1905.

1. Sarcoma of the Bone. — C. T. Holland.
2. Some symptoms of a Toxaemic nature manifested during the course of treatment of non-ulcerating cancer of the Breast. — M. le Dr. Haret.
3. Sarcoma of the Scalp (Recurrent) treated by exposure to X Rays. — T. J. Wood.
4. A note on the Phoretic Treatment of multiple warts by the Mg (So_4) Ion. — Gustav Reus.
5. Recent Advances in Roentgen Ray Diagnosis with Especial Reference to the use of the Diaphragm and Osteoscope in Renal Skiagraphy. — Carl Beck, M.D.

1. Holland reports a case of fracture of the hip by muscular action while endeavoring to escape a kick from a horse. The patient had been suffering pain in this hip for nine months previous. The accident was followed by great swelling and extravasation of blood, and five days later a radiogram showed a comminuted fracture of the neck. Three days later another radiogram showed a new growth extending from the head to the great trochanter. Incision and examination of a portion of the growth showed it to be a round-celled sarcoma. Two weeks later a hip joint amputation was done, but death followed in 28 hours. Attention is called to the value of the ray in making the diagnosis while there was yet no external sign of the growth.

The difference in appearance radiographically of simple exostosis, osteosarcoma, abscess, and simple inflammatory products, is described.

2. Haret describes symptoms of toxæmia arising during radiation of three cases of non-ulcerative carcinoma of the breast. Case 1 was recurrent after two removals and after the fourth treatment vertigo, palpitation, and complete anorexia followed. These symptoms increased in severity till the patient became too weak to come for treatment, and radiation being thus interrupted she rapidly recovered, and under renewed treatment made rapid improvement.

Case 2 was in good general health and had simply an indurated nodule in the breast. Following the fifth treatment there developed violent cephalgia, palpitation, anorexia, insomnia, and extreme prostration. Treatment was stopped, symptoms disappeared; treatment was resumed, symptoms reappeared and patient discontinued the treatment.

Case 3 was a recurrence following operation and under treatment developed the same train of symptoms.

Haret discusses the possibility of these phenomena being due to a physiological action of the X-ray, or to suggestion, but *believes* them to be manifestations of toxæmia following absorption of morbid products which, in ulcerating cases, would discharge externally; he advises that in non-ulcerative cases an incision be made to provoke evacuation of such toxic material.

3. Wood's case had been operated upon four times for removal of a sarcomatous tumor of the scalp and its recurrences. The growth was a small round-celled sarcoma. Treatment was carried on for a year with a successful result (technic not given).

4. Reus claims that the success of local medication is conditioned by two factors: The one the uniformity with which the drug can be distributed through the diseased tissues, the other

the possibility, in making an application, of determining the direction of its flux.

Ordinary methods reach the more superficial layers of the skin only, but electrical methods fulfill both requirements.

In the case of multiple warts of the scalp and forehead, a bandage soaked in a saturated solution of the double sulphate of potassium and magnesium was applied and covered with potters' clay in which the negative electrode was imbedded. The feet were immersed in a salt bath, containing the positive electrode. A current of from 7 to 35 ma. was passed for 25 minutes, and a lotion of magnesium sulphate in glycerinated water ordered. Ten days later no vestige of warts remained.

5. Beck describes a very simple compression diaphragm which seems in his hands to be equally as effective as the cumbersome and expensive imported forms. It consists of a lead cylinder having an expanded top and provided with an adjustable arm fixed to the table by means of a clamp.

He calls attention to the advantage of thus employing only the most active sheaf of rays in radiography whereby are eliminated the effects of those rays originating at the tube walls. The principal disadvantage is the restriction of the area which it is possible to radiograph at a single exposure.

1. Imbert believes that X-ray treatment may be used without any danger of causing dermatitis or metastases and that it is suitable not only in inoperable tumors, but that in cases which can be cured in this way it is preferable to an operation. An operation never removes all the disease and is almost always followed by recurrence. He alludes to cases of his own, cancer of the penis, large sarcoma of the lower jaw, cancer of the prostate, uterine fibroids, and a large abdominal tumor regarded as an inoperable osteosarcoma. In all of these cases very great improvement has been effected and the case of cancer of the prostate is apparently well.

2. Belot gives pictures of a case of mycosis fungoides of the face before and after treatment by the X-ray almost cured, after absorption of 500 H. (Holzknecht units). One case of epithelioma of the face, rays No. 5 or 6 (Benoist), total dose absorbed 20 H. Another, rays at 5 or 6, total 35 H. Another affecting the ala of the nose, rays 5 or 6, total 35 H. Another between the ala of the nose and the malar bone, rays 5 or 6, total 49 H. All these were cured, as was also a case of sarcoma of the skin after absorption of 21 H. His technique is summed up as giving as large a single dose as possible without interfering with the integrity of the skin, and repeating it at the shortest interval consistent with preservation of that integrity. In the case of mycosis fungoides the dose at each seance was 7 to 9 Holzknecht units over the tumors and 5 or 6 H. over the erysipelatoid plaques. An interval of 15 to 20 days was allowed between applications.

3. Holzknecht attributes the curative influence of the X-ray to a cellular degeneration which is in direct proportion to the quantity of X-rays absorbed and also in close relation to the amount of reaction visible in the skin. The most susceptible tissues are the lymphatics, skin modified by psoriasis, the tissue of

ARCHIVES D'ELECTRICITE MEDICALE

Bordeaux, France, January 10, 1905.

1. Apropos of Radiotherapy. — Dr. A. Imbert.
2. Some Results from Radiotherapy as to Curative and Cosmetic Effects. — Dr. J. Belot.
3. Roentgentherapy (to be continued). — Dr. Guido Holzknecht.
4. Tube holders and Orthodiagraphy combined. — Dr. Barjon.

mycosis fungoides, skin modified by inflammation, acne, or lupus, epitheliomatous tissue. The moderately susceptible tissues are the healthy skin and its adnexa. The least susceptible tissues are connective tissue, vessels, the margin of areas of alopecia.

He distinguishes four degrees of reaction:

1st Degree. Latent period three weeks. Process of degeneration without inflammatory reaction (desquamation and depilation, absorption of pathological tissues). Integrity of the skin unaffected.

2d Degree. Latent period two weeks. Same phenomena as above, but in addition inflammation without vesication. The skin recovers its integrity without cicatrix.

3d Degree. Latent period one week, and the additional phenomena of vesication, exfoliation, and oozing. The skin recovers its epidermis, it is discolored, and later shows signs of atrophy.

4th Degree. Latent period half a week. Necrosis is added. Finally cicatrizes.

Therapeutically only the 1st and 2d degrees should be induced, except in malignant disease, where the 3d and 4th degrees are sometimes required.

Modes of treatment.

1st. The most common massive doses. Giving the amount required to produce the desired reaction in a single dose, which is not repeated over the same area for four to seven weeks.

2d. Less commonly half doses every two or three weeks, maintaining a permanent state of reaction.

(He considers frequent mild applications as out of date entirely, useful only when there is no way of estimating the dosage.)

Application of the treatment.

He uses a Müller No. 12 tube, also the Müller water-cooling tube. Medium

vacuum, which he estimates by the fine crepitation in the tube and by the presence of an area of blue around the anode. This condition corresponds with 6 of the Walter radiometer scale. If the tube is a little hard turn on a stronger current and the vacuum will fall. If it is very hard reduce the vacuum by means of the regulator. If the tube is a little low use a weaker current and the vacuum will come up. If it is very low do not use the regulator to raise the vacuum, but do this by running the tube with a moderate current (not in treatments) and then laying it aside for a day.

To maintain the proper degree of vacuum the current must be just right, neither too strong or too weak.

Protection of the healthy skin is secured by the use of pieces of sheet lead 11 x 17 inches and 1 millimetre thick and coated with rubber, placed around the area to be treated.

Uniform distribution of the X-ray over the area to be treated is important.

Focus of the tube should be located vertically over the center of the area under treatment and at a distance equal to twice the diameter of the area exposed; but never more than 30 c. m. If area is large expose only a portion at a time.

Dosage.

It is simply a matter of so many Holz-knecht's units. 1 H. is the amount required to give the test capsule the shade of green, shown by No. 1 of the scale in Holz-knecht's chromoradiometer, and is one-third the amount required to produce a visible reaction upon the healthy skin of the face. The test object must be placed at the same distance from the focus of the tube as the part to be treated and must face in such a direction that the rays fall perpendicular to its surface.

Holz-knecht does not believe there is such a thing as an idiosyncrasy by reason of which certain patients are more susceptible than others. He gives a table of his work for the past five years, in

which the number of reactions and the number of lesions (bad effects) are given. Since his chromoradiometer was introduced in 1902 he has caused over three thousand reactions without a single lesion, while during the earliest years there were from five to twenty per cent. of lesions.

4. Barjon describes a vertical framework inside of which the patient stands. By a system of counterpoises the tube and an adjustable diaphragm of sheet lead move synchronously for fluoroscopic or radiographic work. Or the diaphragm may be disconnected and the orthodiagraph brought into play.

ARCHIVES D'ELECTRICITE MEDICALE

Bordeaux, France, January 25, 1905

1. Radiotherapy applied to tumors of the breast. — Dr. A. Beclere.
2. Roentgentherapy (continued). — Dr. Guido Holzknecht.
3. The Use of a Milliampere-meter in the circuit of an X-Ray Tube actuated by a Static Machine or a Coil. — M. G. Gaiffe.

1. Beclere analyses the results in 45 cases of neoplasms of the breast treated by him in the last seven months. Twenty-five were cases in which recurrence had followed one or more operations and the surgeon had considered further operation contraindicated. Some of these recurrences were simply nodules or plaques in the skin and disappeared entirely under treatment. Others were subcutaneous nodules or plaques and did equally well.

His treatment for all non-ulcerated cases is as follows:

1st. Apply at each seance the largest dose compatible with the integrity of the skin.

2d. Repeat the doses as often as possible, still preserving the integrity of the

skin. In practice 4 H. (Holzknecht units) is the limit of each dose and one week the shortest interval between doses.

He then recites several recurrent cases with ulceration, in which the ulceration healed altogether or in part, a wonderful improvement took place in the patient's physical condition, and the pain was relieved. In most of these cases, however, there were evidences before the treatment was begun of deep-seated glandular involvement, with oedema of the arm, and some of these patients are now dead. Beclere does not think radiotherapy will check intrathoracic neoplasms after they have once developed. He thinks widespread radiotherapy desirable after an operation for cancer of the breast as a means of preventing recurrence.

In a second class are the cases which have not been operated on, but which are considered inoperable on account of their extent, the age of the patient, or other conditions. These were almost all scirrhus in type and in all the tumor became harder and smaller under radiation and they are distinctly localized. Improvement took place in the general condition. The development of the tumor was checked, but its disappearance was not effected. He has treated a few cases which were readily operable, but in which the patient dreaded the knife and a couple of months delay was agreed upon to see what could be done with the X-ray. He has seen too few of these and for too short a time to express an opinion in connection therewith.

2. Holzknecht continues his article on Roentgentherapy by detailing its "Applications."

Cutaneous Epithelioma.

Uniform application. Protect surrounding sound skin except for a border of 1 cm. One full dose repeated at intervals of a month. Dose 4 or 5 H. Latent period 2 weeks. Reaction of second degree appears in the course of the third week. Course: cleaning up in

case of papilloma, absorption in ulcerated and infiltrated forms, cicatrization. Unless there are little persistent foci there is no recurrence. Total duration of irradiation 5 to 20 minutes. Duration of the course one to several months. Rapidly developing cancer of the skin does not respond so favorably. Dose 10 to 20 H. Is indicated in all superficial epitheliomata which have not invaded the entire thickness of the skin. If there are deep foci these may have to be excised in addition to applying radiotherapy.

Favus.

Uniformity of application very necessary. Only one full dose, and if the hair does not fall out at any point immediately, repeat the dose there. Dose, 4 or 5 H. Latent period two weeks reaction of second degree, desquamation often in large flakes. This does not need to be arrested by salves. Hair ought to begin to come in at end of six weeks. No recurrence of disease unless some parts have not been sufficiently irradiated. Case should be cured and hair fully restored in three months.

Tinea Tonsurous.

The same as in favus.

Alopecia Areata.

There are two forms, one curable by the X-ray, the other not: the only way to find out is to treat a limited area and wait three months and see whether the hair comes in. If not, abandon the treatment. If it does succeed treat the rest of the area. One full dose for the beard, 3 or 4 H.; for the scalp, 4 or 5 H. Course, depilation of the exposed borders 2 cm. around the bald areas. Hair appears on bald areas in seven weeks, a little before it reappears on the surrounding sound skin. No recurrence. Cure should be complete in three months.

Mycosis Fungoides.

One full dose: in the case of large

tumors give an additional half dose after they are effaced. Dose, 3 to 5 H., according to size of the tumor. Latent period 5 or 6 days. Reaction 1st degree. Recurrences are not due to failure of treatment, but to the fact that it is not a local disease. They are treated in the same way. Even in cases apparently cured and remaining well for a year death may occur from internal metastases.

Acne Vulgaris.

Uniformity of ray distribution is important. Tube (target) located at 18 cm. distance in four different positions somewhat in front and to either side for the cheeks, the upper lip, and chin. In front of the forehead and under the chin, with the head thrown back. In protecting the sound skin leave a wide margin exposed around the disease. Protect the mucous membrane of the lips. One single full dose for the face, 3 or even $3\frac{1}{2}$ H.; for the body, 4 or 5 H. Latency 1 week, reaction of 2d degree over inflammatory nodules. 1st degree over intermediate areas. Course: aggravation, appearance of new nodules, desquamation, cure. If some circumscribed foci remain another full dose must be given. Duration of treatment one month and a half. Indicated in all obstinate cases, those of the trunk being especially favorable.

Sycosis.

Forbid the use of the razor and scurfing or caustics. Application same as for acne. Dose, $3\frac{1}{2}$ H. or even 4 H. Latent period 1 week. Reaction, 2d degree. Course: exacerbation, the pustules open and new ones form, depilation, cure, with reappearance of hair in two months. The patient should not shave for a year. For recurrences, 2 H. at intervals of three weeks.

Psoriasis Vulgare.

Not necessary to protect the sound skin, except the hairy scalp and face.

One full dose. Face 2 H., body $3\frac{1}{2}$ H. In a word, doses which will not cause an inflammatory reaction, for if such a reaction occurs it will bring on an eruption, even in an area previously free from it. Latency 1 week, reaction, 1st degree. The plaques fade and desquamation supervenes. Even rebellious cases do so, but, as with other methods, recurrence is possible. Exposure, three to ten minutes over each area, but for a general case this will amount to a total of about seven hours. Cure in a month.

Scrofuloderma.

A full dose, repeated from three to five times after subsidence of reaction. Dose, 3 to 5 H. Latency 2 weeks. Reaction, 2d degree. The sluggishness of the morbid process disappears, even subcutaneous nodules and glands shrink; ulcers clean up and are covered with epidermis, and fistulous tracts cease to discharge. Usually the nodules, even if they have softened at the center, do not require surgical intervention. Cure in three to five months.

Lupus Vulgaris.

There is one form of lupus planus in which there are separate lupoid nodules with much modification of the skin; in this form radiotherapy is contra-indicated.

Ulcerative lupus planus is treated by a full dose, repeated once or twice after the end of reaction, until cicatrization has occurred. Dose, 3 H., as a preparation for Finsen treatment, otherwise 4 H. Latency 8 days, reaction, 2d degree, lasting three weeks. Rapid cicatrization and conversion into the first variety. Then phototherapy would be the thing. Cure in about two months.

Hypertrophic forms with or without ulceration. One method, half doses every fourteen days for two or three months until growth has flattened out; then wait for subsidence of all inflammatory signs and if necessary begin over

again. Dose, 4 H. When the growth has been reduced to the level of the skin the X-ray is contra-indicated and phototherapy is called for. Second method, full doses once every month for five to ten months. Dose, 3 to 5 H.

Warts.

Important to protect the sound skin. Half doses every eight days or a single full dose. Dose, 8 H. Cure in a month.

Hypertrichosis.

A. Cases occurring about the menopause. Full doses, repeated every five to eight weeks after subsidence of reaction. Dose, 3 to 5 H. Latency 2 weeks. Reaction, 2d degree. Course is redness, desquamation, depilation, decolorization. After three or four reactions the hair ceases to grow or only a few colorless fragile hairs remain, and there is an atrophic (senile) appearance of the skin. Treatment is stopped at this stage and the remaining hairs are depilated. Cure in four months.

B. In young persons about puberty, X-ray therapy only indicated when very disfiguring. First method consists of full doses repeated five to fifteen times at intervals of six or eight weeks. Dose, 3 H. This is an undesirable method, causes permanent and progressive atrophy of the skin.

Second method. 2 H. every three or four weeks for six months. Then stop for two months and begin afresh if required by development of hair and not contra-indicated by atrophy of the skin. Continued state of reaction between the first and second degree for six months. Besides the atrophy there may remain a number of very fine vascular ectasiae. Cure in one to three years.

Carcinoma or Sarcoma of the Skin.

In case of ulceration 8 to 10 H. at one sitting, then 2 H. every week. In non-ulcerated cases 4 H. at once, then 2 H. every week. Pain disappears, often in

twenty-four hours; gangrenous portion is eliminated, partial healing takes place, but never complete cure.

Some deep-seated sarcomata are cured. Also cases of osseous and articular tuberculosis with sinuses are cured.

Also in cases of leucaemia a single radiation over the spleen, the liver, and the long bones and hypertrophied glands, 4 H. In two or three weeks the number of blood-cells approaches the normal and the general condition is improved.

4. Gaiffe's milliamperemeter measures the current passing through the X-ray tube. With the same resistance and the same regulation of the interrupter in the primary circuit of the coil, and the same tube, it is only necessary to regulate the vacuum of the tube so that the milliamperemeter will give the same reading. It does away with the necessity for measuring the spark resistance and the use of the radiometer for determining the degree of vacuum in the tube.

ARCHIVES D'ELECTRICITE MEDICALE

Bordeaux, France, November 10, 1904.

1. Observations on the Treatment of Carcinoma and Epithelioma by the X-Ray. — Dr. H. Guilleminot.
2. A Case of Rodent Ulcer of the Back Treated by Radiotherapy. — Dr. Etienne Henrard.
3. Law of Muscular Contraction under Electrization by Condenser Discharges. — Dr. J. Cluzet.
4. Graphic Tracings of the Faradic and Other Intermittent Currents. — Dr. Lewis Jones.
5. Paquelin Blow-pipe for Heating the Osmo-Regulator of Chabaud Tubes.

1. Guilleminot reports a successful result in a woman seventy years old with a scirrhus of the breast adherent to the skin and chest wall, retraction of nipple, and ulceration measuring forty-four by thirty-five centimeters. Bianodal tube,

twelve inch coil with mechanical interrupter, seven amperes in primary, direct current of 110 volts. Rays No. 7 as determined by Benoist's radiochromometer. Anticathode 15 to 18 centimeters from the skin. Lead shield surrounding tube except at window. Tin foil over neighboring skin held in place by diachylon plaster. Twelve treatments in the first month, eight or ten minutes each. Uses the tin foil in all cases, because, 1, it is hard to adjust tube and shield so as to exactly limit action of ray; 2, difficult to prevent patient from moving; 3, desirable to treat surrounding area to some extent and the tin foil arrests the rays likely to cause dermatitis, and lets the others pass. Patient left city at end of month; ulcer had begun to heal and was covered by a thick crust. When this subsequently came away ulcer was found to have healed.

At the end of twelve treatments there was slight redness of the leg on the affected side. Three months after phlebitis developed, which he does not attribute to the treatment but to the amount of traveling about that the patient had to do—two hours journey in each direction—in order to be treated. A new ulcer formed; eight applications of radium of 7,000 activity, 1 decigramme, about an hour at a time produced no effect. Ulcer had then become larger than when first treated. The X-ray from a portable apparatus, 10 cells of storage battery and mechanical interruption, being used. Ulcer began to heal at once. Slight set-back attributed to use of too high a tube, 8 or 9 of Benoist's scale, reduced to No. 5; ulcer completely healed in three months. Had been well without treatment for three months at date of report.

Another case was one of epithelioma of the dorsum of the nose, somewhat elevated. Ulceration size of a silver ten cent piece. Treatments 10 minutes each with rays number 5 or 6 on Benoist's scale, three times a week for eight treat-

ments. Completely healed during the months after treatment was stopped. Six months later there remained only a whitish, somewhat depressed, healed surface surrounded by some hyperpigmentation. Three additional treatments caused the skin to assume a normal appearance.

Two other cases were carcinomata of the breast, recurrent after operation, both of very rapid growth, one being cancer *en cuirasse*. Treatment was unsuccessful, but did cause disappearance of outlying cancerous nodules.

2. Rodent ulcer of the back, 42 centimeters in diameter, in a woman 65 years old, of 8 years' duration without previous treatment. Daily treatments for a month, 16 inch coil, mercury interrupter about 600 times a minute, 60 to 70 volts, 5 amperes in primary. Müller tube No. 13 with regulating wire set at 7 centimeters, anticathode 15 centimeters from skin, surrounding area protected by sheet lead 2 mm. thick, ten minutes for each exposure. Gradual healing of ulcer and disappearance of nodular masses. Treatment stopped at end of a month. Healing process continued and in two months from the beginning nothing remained but a smooth and slightly pigmented surface of sound skin.

3. Starting with Weiss' general law that the quantity of electricity required to produce muscular contraction is equal to $a + bt$ (a and b being co-efficients depending upon the nerve and the conditions of the experiment, and the time required). Mathematical calculation by means of graphic formulæ and others to work out a formula for application to the special case of muscular contraction produced by condenser discharges. Result the equation:

$$c (V_0 - bR) = a + bRC_1 \frac{V_0}{bR}$$

from which it follows that the quantity of the charge, C , required to produce contraction varies inversely as the potential V_0 .

The calculation is purely theoretical and the article does not refer to any animal experiments to verify the result.

4. With collaboration of Drs. Head and Reginald Morton, a study of curves showing the strength and direction of the current in secondary coils. When the primary coil has a small number of turns and no iron core there is very little self induction and the secondary current reaches its maximum in $1/4000$ of a second after the make or break and maintains it up to a sudden drop at the break or make. With a long primary coil and an iron core great self induction, secondary current slowly and gradually established, and increases right up to the end (make or break), suddenly falls to zero, and increases steadily in the opposite direction. A mechanical interrupter usually gives imperfect makes and breaks and is slow, the secondary current from it has irregular curves and is hard and painful to the patient in either diagnosis or treatment. The presence of an iron core has more to do with producing a long gradual secondary wave than has a primary coil with a large number of turns. Primary coils with little self induction produce secondary currents which cause comparatively little discomfort. In any coil the opening and the closing waves are very unequal.

He prefers to use no coil at all, but a direct current interrupted as by Le Duc's, or, better still, by his own mechanical interrupter, in which the current is alternated as well as interrupted. The advantages over any form of induced current are that the current can be measured directly in milliamperes or volts, the frequency of the interruptions can be regulated and measured instantly, and, finally, the painful effect is very greatly reduced.

5. The Paquelin Chalumeau or blow-pipe for heating the osmo-regulator of X-ray tubes consists, like the Paquelin Thermocautery, of a double bulb for producing a continuous flow of air

through a metal receptacle containing gasoline. Thence the carburetted air passes through a handle to an open jet at which the gas is set fire to by a match. There the flame continues, intense and easily dirigible, as long as the vapor-laden air is forced through the tip by pressing the bulb. The handle is of non-conducting material to protect the hand from heat and there is a device to prevent the flame from traveling back through the tube and exploding the gasoline contained.

ARCHIVES D'ELECTRICITE MEDICALE

Bordeaux, France, November 25, 1904.

1. Radiotherapy in the Treatment of Cancer. — Taffier and Haret.
2. The Electric Spark. — Stephane Leduc.
3. Treatment of Diffuse Sarcoma of the Skin, Premycosis, and Mycosis Fungoides by Radiotherapy. — Belot and Brisserie.

1. Taffier and Haret say that as early as 1896 certain accidents to patients and operators called attention to the effect of the X-ray upon living tissues. Freund and Schiff studied the question, but the credit for the introduction of radiotherapy is given to Williams of Boston. Despagne in France also published two cases, one of cancer of the stomach and one of tumor of the tongue, in which a cure was supposed to have been accomplished, but both patients subsequently died.

Since the publication of Albert-Weil's article in the *Journal de Physiotherapie*, June, 1903, other authors have published a great many more or less complete reports on the subject. Beclere gave the method a scientific posology by calling attention to the importance of the radiochromometer and the chromoradiometer, enabling us to secure better results and to avoid accidents. It is important to distinguish between the clinical varieties of epithelioma, though they all have

practically the same pathology. An epithelioma near the inner canthus of the orbit is so benign as to merit the name cancrroid, while one of the lower lip, or especially at the commissure of the lips, is a more or less rapidly fatal disease. They report the following cases:

Case 1. Man of sixty-six. Epithelioma for ten years on portion of face near the ala of nose, 3 cm. vertically, 2 cm. horizontally, deeply ulcerated. Diagnosis confirmed by microscope. Treatment three times a week. After absorbing X-rays equivalent to 2 H. (units of Holzknecht's chromoradiometer) there was no more hemorrhage, after 6 H. no more pain; after 22 H. it was completely healed.

Case 2. Woman of 86. Epithelioma for 10 years side of nose and below eyelid. Two treatments a week 1 H. absorbed at each treatment. At 12 H. granulations appeared, at 38 H. the nose was healed, and at 57 H. the ulceration below the orbit. There was never the slightest reaction in the skin. In this case the treatment took longer than usual, because the patient was away for a month.

Case 3. Woman of 68. Epithelioma for 18 years. 2×3 cm. dorsum of nose and extending toward inner canthus. At 9 H., with one treatment of 3 H. a week, pain disappeared, at 15 H. hemorrhage ceased, at 50 H. completely healed.

Case 4. Woman of 36. Breast and axillary glands removed six months previously for a tumor. Recurrence in the shape of a little tumor the size of a pea under the skin, pain radiating into axilla and down arm. Two treatments a week of 2 H. over tumor and 2 H. over axilla. Disappearance after 18 H.

Case 5. Woman of 26. Operated on four months previously, removal of breast and axillary contents; recurrence in the shape of two little glands in the depths of the axilla and pain in the arm and back. Axilla, arm, and breasts were

radiated. After 15 H. cured. Seen a year later, no pain or enlarged glands.

Case 6. Woman of 39. Operated on twice. Third time X-ray treatment. Arm oedematous. Twice a week 4 H. to axilla in order to rapidly produce an intense reaction. When this occurred treatment was suspended for a month and then 2 H. at each treatment. At 21 H. pain and swelling were gone. No microscopical examination in these three last cases.

Case 7. Woman of 60. For four years tumor the size of a walnut in right labium majus. One application a week of 3 H. Never any reaction. Disappearance after 24 H.

Case 8. Man of 50. Growth in floor of mouth of three months' duration, submaxillary adenopathy, microscopically tubular epithelioma. One application a week of 4 H. applied also to the submaxillary region. No change at first, but at 40 H. the glandular masses began to diminish and at 54 H. the floor of the mouth appeared normal. Treatment stopped. No recurrence for a month, but later new glands appeared and treatment is still under way with hopes of a permanent cure.

It is important to continue treatment for some time after apparent cure. The X-ray certainly has a selective action upon neoplastic cells. Possibly Schwartz's observation in Holzknecht's laboratory in Vienna that the X-ray decomposes lecithin into trimethylamine may explain the action of the X-ray upon cancer cells which contain lecithin in large amount. But this observation needs further investigation.

Taffier and Haret recommend the X-ray:

1. In the treatment of epithelioma of the face (cancroid), where a cure is certain and rapid and the cicatrix perfect, it is the management to be preferred.

2. In the treatment of all cutaneous

epitheliomata in which surgical intervention is for any reason contraindicated.

3. In recurrence after operation for cancer of the breast.

4. After operations on new growths, in the hope of preventing recurrence.

2. Leduc has made photographs of the electric spark upon non-halation plates, passing the discharge through compressed red oxide of mercury. He has secured images which are clearly defined and show the individual spark to consist of an areola of concentric circles around each of the two points, and lines passing between the two points. The conclusion is that the lines represent changed molecules driven from one pole to the other and that the areolas represent neutral molecules grouped about each pole. He thinks this agrees better with the general laws of electricity than do some of the other explanations of the composition of the electric spark.

3. Diffuse Cutaneous Sarcoma. Belot and Brisserie report as follows:

Case 1. A man with three confluent tumors on the back, hard, slightly elevated, pruriginous, diffuse borders; five months development. Treatment by Chabaud-Villard osmo-regulator tube, ten-plate static machine, exposure 15 minutes at 10 cm. from anticathode, low vacuum corresponding to 6 of Benoist's radiochromometer. Dose absorbed at first treatment 4 or 5 H. (Holzknecht's chromoradiometer). Second application the following day. Exposure 10 minutes 3 H. Two weeks later patient again seen, tumor considerably effaced, and itching relieved. Again treated and two weeks later seemed entirely cured. Patient had not returned for observation.

Case 2. Right thigh and left leg diffuse sarcomatous infiltration, diagnosis confirmed by microscope; complete cure of thigh and great improvement of leg.

Cases 3 and 4, of melano-sarcoma, have been very much improved.

Their general technique for diffuse

sarcoma of the skin is to cause the affected part to absorb at the first one or two treatments, a total dose of 6 or 8 H., which may be increased to 9 or 10 H. if the lesion is grave and its extension rapid. The penetration of the rays must be slight (rays No. 5 or 6 of radiochromometer) if the lesion is cutaneous. The reaction excited is usually slight, but is sometimes active, amounting to slight dermatitis with some exfoliation which passes off quickly. The interval between treatments is 15 to 20 days. They have never had any accidents.

Mycosis fungoides and premycosis. Two cases confirmed by microscope and another clinically diagnosticated. Low vacuum (4 or 5, never more than 9), and 10 H. on each tumor in each seance or couple of seances; then wait 15 or 20 days, then another application of 7 to 8 H., and again an interval. This method is continued until the lesion entirely disappears, the dose being gradually diminished. Some nodules require as much as 35 to 40 H. in all. Some are cured by 9 H. In the premycotic stage without much induration a smaller dose is used (4 or 5 H.) and very often one treatment produces a cure.

It is undesirable to produce an X-ray dermatitis in mycosis cases, but these spots will stand, with only a slight erythema, a dosage which will excite a more severe reaction in the normal skin. The itching in these cases is very promptly relieved by X-ray treatment. They have never seen the slightest bad effect upon the general health of any of their patients in consequence of X-ray treatment. One patient received daily treatments of from 5 to 7 H. for a whole year without bad effects, and he has increased in weight. They consider the X-ray a wonderful agent in the treatment of mycosis. It is too early to tell whether a recurrence may take place. They believe that the quality of the ray and the amount absorbed are the important factors. The form of the apparatus, distance from tube, etc., are only minor details.

JOURNAL DE PHYSIOTHERAPIE

Paris, France, January 15, 1905.

1. Methods of Treating Hypertrichosis.—Dr. E. Albert-Weil.
2. Notes on the Therapeutic uses of the Salts of Radium.—Dr. A. Beclere.

1. By the electrolytic method Albert-Weil's technique involves the use of a carbon positive electrode covered with wet gauze, which is grasped and released by the patient, thus causing the current to flow or stop. An irido-platinum needle is thrust into the hair follicle and the current then allowed to flow. From 2 to 5 milliamperes are used for 5 to 20 seconds and then the patient lets go of the electrode until after the needle has been introduced into another follicle. The operator does not have to turn the current on or off or to touch the rheostat until a more sensitive part of the face is treated.

The loosened hairs are pulled out at once and it is practicable to remove 50 or 60 at a session; the sessions are best two days apart. The treatment stimulates the growth of lots of new hairs and there is some return of the old ones, so that the treatment has to be repeated from time to time. Altogether removal of a regular beard involves the destruction of between 10,000 and 20,000 hairs. The treatment is certain, more or less painful, and leaves some scars.

Treatment by the X-ray is applied in such a way as to cause depilation without inflammatory reaction. He applies to each part of the affected area a dose a little smaller than the limit laid down by Lubourand and Noire, and in patients with very fine skin he gives this in divided doses. About fifteen days later most of the hairs fall out or may be easily removed. The treatment is then repeated at intervals of eight days. If erythema takes place he stops for six or eight weeks and recommences with milder doses. The hair which has fallen out returns in about two months and must be caused to fall out again and still

a third time. After this it is so reduced that an annual treatment will suffice in the future.

2. Beclere reviews the history of the discovery of radium and the fact that the element itself has not been isolated: it is only its salts that are known. Also the fact that there is a great difference between the emanations from radium, which are destructive to the smaller mammalia, and the radiation from radium. The former is not useful therapeutically and is all stopped by the wall of the vessel containing the radium.

The radiation is composed of Alpha rays, which are positively electrified, deviable by a magnet in an opposite direction to that in which cathode rays are deviated; they are similar to the kanalstrahlen in a Crooke's tube. Beta rays, which are negatively electrified, deviable by a magnet the same as cathode rays and similar to them; and Gamma rays, not electrified and not deflected by a magnet, and similar to X-rays.

They all cause fluorescence, affect a photographic plate, produce coloration in a great many substances, render the air a conductor of electricity (ionize it), and modify the cellular elements of living tissues. All these properties are similar to those of the X-ray.

The effect of an application of radium is proportional to its degree of radio-activity and to the amount of the substance employed. Beclere uses an applicator which is eleven millimeters square, has an aluminum bottom one-tenth of a millimeter thick, and contains a layer of a radium salt six or seven-tenths of a millimeter thick. This can be applied in the throat as well as on the surface of the body. Its square shape enables one to accurately cover a large area by several applications which a round box would not.

Measured by Holzknecht's chromoradiometer 15 centigrammes of 500,000, radio-activity produces 4 H. in 30 minutes. But this does not necessarily

mean that it will produce the same cutaneous reaction as 4 H. of the X-ray. It does not do so principally because it has very little penetrative power. In other words, radium acts like an excessively soft X-ray tube. Using a Benoist's radiochromometer divided into half degrees, and making a radiogram with 2 milligrammes of bromide of radium, 10 centimeters from the photographic plate for 8 hours, the resulting picture indicates one-half degree of penetration. Clinical experience confirms this. Beclere applied a glass bulb containing 43 centigrammes of pure radium bromide for 5 minutes to cutaneous nodules constituting a recurrence after an operation for cancer of the breast; to another place it was applied for 10 minutes. Severe reaction appeared in the skin, with superficial destruction, after the longer application, followed by a scar, but no effect was observed on the *nodules* which would have readily disappeared under the X-ray.

There are three classes of cases to which radium salts are applied. One, the group of algias in which the relief of pain may be due to suggestion. Another class includes arthropathies. An perhaps in these cases the disappearance of symptoms is accidental. The third class includes lesions of the skin or mucous membranes such as lupus or cancer, which have a fatal tendency. Radium may be applied in these cases to sites where it is very difficult to apply the X-ray effectively. The real indication for the use of radium is in lesions of slight extent either of the surface or of depth where anatomical location renders it difficult to use the X-ray.

BULLETIN OFFICIEL DE LA SOCIÉTÉ FRANÇAISE D'ELECTROTHERAPIE ET DE RADIOLOGIE.

Paris, France, December, 1904.

1. Tubes for Internal Radiotherapy.—
Dr. L. Kocher.

2. Action of the Continuous Current upon the Vitality of Microbes.—Dr. S. Schatzki.

1. One of Kocher's tubes has a large bulb with a tubular prolongation at the extremity of which is the cathode mirror. A long stem passes from the positive pole of the tube and terminates in a disk within about an inch of the cathode. This anticathode is inclined at an angle of forty-five degrees, and there is a coating of asbestos and bismuth to prevent the action of the rays except in the proper lateral direction. There is a thin hard rubber jacket over this prolongation to prevent sparks reaching the patient from the tube or from the heavily insulated negative wire which emerges at the extremity of the prolongation of the tube.

The other of Kocher's tubes is like an ordinary X-ray tube with a tubular prolongation opposite the anticathode. Instead of making the bulb proper of glass opaque to the X-ray, he suggests enveloping it in an opaque case.

2. Most of the work done upon this subject by previous observers has been directed toward ascertaining the effect of the current at the two poles, and with currents a great deal stronger than are used in therapy. In his own experiments cultures of micrococcus prodigiosus, bacillus of chicken cholera, and streptococcus were placed in a glass tube one centimeter in diameter and twenty centimeters long. The ends of the tube were bent up for a distance of eight centimeters and a similar eight centimeter vertical tube connected with the horizontal tube at the middle of the latter. It was from this middle tube that cultures were taken and in each case without interrupting the current of electricity. Platinum electrodes in the two vertical ends of the tube were connected with a galvanic battery of forty cells and a milliamperemeter was used to measure the current employed.

It was found that currents of from

twenty to thirty milliamperes, applied for from ten to forty-five minutes, produced no effect upon bacteria. The strength of the current could not be increased beyond this point because the heat generated in the small body of liquid would have introduced a new and foreign factor into the experiment, so the length of the application was increased.

Micrococcus Prodigiosus.

Colonies galvanized for an hour and a half gave less vigorous cultures and after two hours galvanization scarcely any culture at all: in no instance, however, was the culture entirely inhibited.

Bacillus of Chicken Cholera.

The original culture and those galvanized for different lengths of time were inoculated into rabbits. The galvanized cultures required a much longer time in which to kill than those ungalvanized. In those galvanized for an hour and three-quarters the virulence was entirely destroyed and all the animals inoculated, lived. In no case, however, did the process appear to hinder in any way the development of further cultures in vitro.

Streptococcus.

White mouse inoculated with original culture died in sixteen hours: when with culture that had been galvanized for forty-five minutes, in forty hours; cultures galvanized for one hour and forty-six minutes and for two hours and ten minutes did not kill the mice. Cultures in vitro developed normally from the galvanized cultures.

In the human body he believes that the same bactericidal effect is produced, partly by stimulation of the leucocytes and tissue cells and partly by destructive influences exercised by nascent chlorine and oxygen, which are produced in the tissues by electrolysis. Far heavier currents can be used on the human body than was possible with his experiments, because no heating effect would have to be avoided, except in so far as the integrity of the skin was concerned.

ELECTROTHERAPY

PRESENT PROBLEMS IN PHYSICS

T. E. Nipher, *Science*, November 11, 1904.

Professor Nipher calls attention to some very suggestive evidence bearing on the intrinsic physical nature of an electric current.

Rowland's rotating disc experiment, showing that an electrically charged body moving with high speed will develop a magnetic field like a current, taken in conjunction with Rutherford's recent work on the magnetic deflection of the electrons of a radioactive body, indicates that a "positive current of electricity flowing in a positive direction" is not at all the same thing as "a negative current of electricity flowing in a negative direction."

These experiments, with others, indicate that these two streams either are or are produced by actual masses of matter in oppositely directed motion, and the question is asked if they are the necessary components of every electric current; i. e., whether every generator is really pumping into each end of the conductor oppositely charged electrons. If this be so, the startling suggestion is made that possibly after long continued use a conductor may "become clogged" and perhaps become radioactive in consequence of its supercharges of electrons.

Wheatstone's famous experiment is recalled, in which a condenser discharge through a long metallic conductor, shows its presence at both ends of the circuit an appreciable interval before it appears in the middle of the conductor. This is suggested as evidence that opposite currents start at each end and become superposed after a short interval of time.

It is urged as probable, however, that discharges like the above, or from a Holtz machine, differ from the current produced by a continuous generator like a dynamo. In the latter case if both positive and negative currents co-exist,

they are probably superposed in the generator.

ELECTRO-DIAGNOSTIC CONTRIBUTION

W. G. Huet, *Zeitschrift für Elektrotherapie*, Breslau, Germany, Vol. 6, No. 11, 1904.

Huet reports three interesting cases, two of which were characterized by affections of the oculomotorius, while the third one was an isolated paralysis of the musculus extensor hallucis longus. These cases deserve attention from an electro-diagnostic point of view.

THE TREATMENT OF NEURASTHENICS WITH HIGH ARTERIAL PRESSURE BY MEANS OF HIGH FREQUENCY CURRENTS.

Ugo Gay, *Zeitschrift für Elektrotherapie*, Breslau, Germany, Vol. 6, No. 12, 1904.

Prof. Huchard deserves the credit for having first proved that increased arterial pressure does not always indicate an anatomical alteration in the circulatory apparatus, but is often the sign of a simple functional disturbance, which slowly becomes the cause of material lesions of blood vessels. This occurs in different affections, notably neurasthenic conditions. Here the extraordinarily beneficial effect of high frequency currents is not enough known and appreciated.

The author has treated 12 such cases and comes to the following conclusions:

(1) High frequency currents of the autoinduction method increase metabolism in neurasthenics, thus producing a quick removal of poisonous substances from the blood and a lowering of blood pressure.

(2) Improvement of subjective symptoms goes hand in hand therewith.

(3) High frequency currents are to be recommended in the early treatment of arteriosclerosis.

ELECTRICITY IN OTOTOLOGY

J. J. Richardson, *N. Y. Med. Jour. and Phila. Med. Jour.*, February 25, 1905.

In this paper attention is called to the meager employment of electricity in aural diseases, except by electro-therapeutists, who show a lack of knowledge of aural affections. The writer believes that electricity in its various forms may be employed (1) to stimulate weak muscles, (2) to relieve pain, (3) stimulate absorption of inflammatory exudates, (4) overcome stenosis or complete strictures, and, (5) at times to revive nervous activity.

In order to get satisfactory results it is necessary to have not only a knowledge of the physiology and pathology of the parts we are treating, but a thorough understanding of electrophysiology and electrophysics. The apparatus employed must be of the highest standard. He believes the action of electricity on the auditory nerve to be an interesting phenomenon. The effect produced by its application resembles ringing of bells, buzzing, and sometimes musical tones, the constant current alone being employed in this form of investigation. Four to eight milliamperes are usually necessary to produce results. More or less serious difficulty is encountered in bringing about this normal excitability, on account of the auditory nerve being so deeply placed and surrounded by its bony envelope and the labyrinthine fluid. It is difficult to avoid excitation of the auriculotemporal nerve. Cough is sometimes produced. Other symptoms referable to brain excitation are frequently shown when attempts to stimulate the auditory nerve are made. These symptoms are giddiness, vertigo, paleness, nausea, and tendency to syncope.

The author thinks that the normal excitability of the nerve is distinctly modified by pathologic conditions, the reaction appearing with much feebler currents where perforation of the tympanum exists, or when labyrinthine disease is present. This modification does not obtain in non-inflammatory diseases of the ear, nor where tumors, cerebral hemorrhage or brain softening are present. He recommends a bifurcated intra-auricular electrode, the metallic ends to be covered with moistened absorbent cotton when galvanic and faradaic currents are employed.

For the indifferent pole an ordinary sponge electrode is held in the hand.

For use in the eustachian tube an insulated catheter is employed, through which a metallic bougie electrode is passed and the negative pole of the continuous current is employed. The same method may be used when the use of the faradaic current is desired in this location.

For strictures of the eustachian tube three to six milliamperes should be allowed to pass for six or eight minutes; at the same time gentle pressure should be made upon the bougie.

He believes that cocaine anæsthesia of the external canal and drum membrane can be produced by the cataphoric process.

THE REDUCTION AND CURE OF MYOMATA BY FARADIZATION

E. Witte, *Deutsche Woch.*, November 3, 1904.

The method employed by the author in the treatment of myoma of the uterus is as follows: He uses a uterine probe the lower seven cm. of which is wrapped in cotton, while a short "cross-beam" higher up prevents it from going too far into the cavity. This probe is made the active electrode, the dispersing electrode being placed on the abdominal wall. The treatments are given daily and have

a duration of from 20 to 30 minutes and a current strength that is just endured by the patient without pain or inconvenience. During an experience of two years no accidents have happened except to one patient, who is stated to have had a hemorrhage after the faradism.

His conclusions are: faradization, in proportion to the employed current strength, causes contractions of the uterine muscles, which are distinctly felt as "labor pains" by the patients. These contractions stop even long-lasting hemorrhages, inhibit the further growth

of the myomatous uterus, and cause a reduction of the tumors, so that they become smaller and at last disappear, and the uterus is reduced to the size which it probably exhibited before the neoplasm developed. No disadvantages or dangers seem to be connected with this method.

(The author does not mention the kind of faradic battery he uses, the number of interruptions, whether he employed the positive or negative pole, etc. These omissions greatly reduce the value of his article.)

RADIODIAGNOSIS

THE COMPRESSION CYLINDER IN SKIAGRAPHY OF CALCULI

Henry Hulst, *American Medicine*, December 24, 1904.

For one accustomed to work with this instrument the difficulties of Roentgenography are reduced to one-half.

Most authors attach much importance to the chemic composition of the stones, as far as their skiagraphy is concerned. Rumpel, on the contrary, insists that this is a comparatively negligible factor, inasmuch as stones are seldom chemically pure. But even chemically pure uric acid calculi do not escape him, so that he boldly maintains: "Every kidney stone can be demonstrated, provided the technic be up to the standard, so that a negative skiagraphic result excludes the presence of stones."

After preparing the patient by high oils and fasting the author makes from two to three exposures on each side of the spine, so as to show the last two or three ribs, the sacro-iliac synchondrosis and the spine, and one over the bladder. If anything resembling a calculus is found, the process is repeated a few days later, except that the compression cylinder is now centered only over the point at which the shadow was found. If all

the negatives thus made show the same well-defined shadow, the diagnosis is positive. If none are found the diagnosis is negative.

The developer which the author uses for exposures of one second or less in chest work he uses also in the development of these calculi plates. It is as follows:

Potassium carbonate, dry, 48 gm. (12 dr.)
Sodium sulphite, dry, 24 gm. (6 dr.)
Potassium bromide, (10% sol.) 59.2 cc. (2 oz.)
Hydrochinone, 16 gm. (4 dr.)
Water, 1 liter (1 qt.)

If the high lights begin to show before 40 seconds, from two to four ounces more of the potassium bromide solution should be added. Development should be complete in four minutes.

SOME OBSERVATIONS ON THE DIAGNOSIS OF RENAL CALCULUS WITH SPECIAL REFERENCE TO DIAGNOSIS BY MEANS OF THE X-RAY

Alexander B. Johnson, *New York Medical Journal and Philadelphia Medical Journal*, February 4, 1905.

Johnson classifies renal calculi in three groups:

- 1st. Uric acid and oxalate of lime.
- 2d. Alkalies and salts of alkaline earths.
- 3d. Cystin, xanthin, and indigo.

While stones of almost pure calcium oxalate or uric acid are sometimes found, most calculi are a mixture of various salts, and are classified according as one or the other ingredient predominates.

A urine containing an excess of a variety of ingredients is favorable for stone formation and in most cases the calculus is formed in the pelvis or one of the calices, thence it often passes down and lodges in the intra-pelvic ureter: thus Leonard found 19 uretral stones out of 30 positive cases.

So long as the kidney remains aseptic the changes consist in interstitial nephritis and fatty changes in the capsules, but infection is followed by abscess, pyelitis, etc. Occlusion of the ureter, if permitted, leads to atrophy of the kidney; gradual obstruction to dilatation of the pelvis and hydronephrosis.

Johnson has examined 125 cases for stones. He has not succeeded in detecting a pure uric acid calculus. In 30 cases a positive diagnosis has been made from the skiagram and confirmed by operation. In 26 cases the stone was in the pelvis or upper ureter; in four cases only in the pelvic ureter.

A stone of oxalate of calcium weighing $1\frac{1}{2}$ grains, in a patient weighing 175 lbs., and with thick abdomen, was shown in three different levels during its passage to the bladder, and was finally passed and weighed. All stones shown have contained appreciable quantities of oxalate of lime, or have been phosphatic.

The current to the tube must be of high voltage and considerable amperage such as is given by coils or large static machines. The tube must permit the passage of such a current for from 10 to 15 minutes without change in vacuum, and the vacuum must be low at the start.

A tube of low resistance gives great detail and shows slight differences in density; a high tube gives a flat picture and may miss the stone.

In stout people a good plate may be occasionally made with a new water-cooled tube of low resistance, which shows brilliant fluorescence, gives a vivid fluoroscopic image of the arm bones at a distance of many feet, and holds up its vacuum under the discharge. He has never made a good picture of a stone with an old tube or one that had become blackened. His best work has been done with a Wehnelt interrupter with a large amount of platinum exposed, giving slow interruptions and large volume of current, and using long exposures (10 to 15 minutes), with the anticathode, 30 inches from the plate.

In thin patients this exposure is cut one-half.

He concludes that the positive diagnosis of stone by the X-ray is reliable and valuable and the negative diagnosis is so to a certain extent.

If the plate reaches a certain degree of excellence, oxalic and phosphatic calculi (but not pure uric acid), may be excluded. Such plates are easily made in children and slender adults and may be made in well-nourished adults by repeated attempts, but if the patient be unusually stout, with thick abdomen and large buttocks, a satisfactory result in his hands and with his apparatus is only occasionally obtained.

THE CARE OF FRACTURES FROM THE STANDPOINT OF THE GENERAL PRACTITIONER

William S. Newcomet, *Medical News*, December 10, 1904.

The various shortcomings of the methods, other than radio-logical, of diagnosing fractures are set forth and instances cited demonstrating the fact that many fractures occur which are not

discoverable by such methods, but which the X-ray would infallibly betray. If the X-ray were used in all fractures many persons who are now suffering from faulty therapeutic results would have joints exhibiting useful functions. Although the law only requires that a physician do his duty, yet the judgment as to whether or not he has done his duty properly is usually vested in a jury. Their verdict is by no means always a just one; radiological data as regards diagnosis, therefore, are not only for the advantage of the patient but also a protection for the surgeon. It is wise, especially in children, to compare the radiological findings of the sound member with those of the member which has been injured.

The practice of tightening a bandage, that is too loose from subsidence of the acute swelling, by simply wrapping a new bandage around the old dressing, is considered to be extremely dangerous as far as the therapeutic result is concerned; so much so that the author considers such a re-application to be always followed by a poor result.

The author's extensive experience leads him to conclude "that too much care cannot be given to our fracture cases, and where doubt exists as to the nature of the injury, it is best to clear up the mystery immediately and not wait until the bones become united and leave a deformity that lasts the remainder of the patient's life. It is not always possible to obtain results that are most desired, but these unfortunate instances would not be so common if in all cases the proper precautions were taken."

REPORT OF A CASE OF SUBPHRENIC ABSCESS, ILLUSTRATED BY SKIAGRAPH

G. E. Pfahler, *Medicine*, December, 1904.

The diagnosis of subphrenic abscess is often quite difficult, as is shown by the

fact that cases have been misdiagnosed by some of our most skillful diagnosticians. It is our duty, therefore, to make use of every additional method of investigation that is at our command. The principal object in reporting this case is to call attention to the information that may be added as the result of a careful X-ray examination.

The patient gave a vague history of an attack of appendicitis, beginning ten days before admission to the hospital. On admission he had some fever, 101, pulse 108, respiration 32. There was slight tenderness in the right iliac region, with an increase in the dullness in the right lumbar region, and an immovable area of dullness above the liver. He had a leucocytosis of 32,200. A diagnosis of subphrenic abscess was made, and while waiting for the surgeon, an X-ray examination was made to confirm the clinical observations.

This showed the right side of the diaphragm displaced upward. It was immobile, and there was a rise in the outer portion of its curve. The lung was clear above. The patient was operated upon, and one and one-half pints of pus removed.

A careful consideration of these points will show that the X-ray will give valuable additional information.

THE VALUE OF TRANSILLUMINATION OF THE STOMACH AS AN AID TO DIAGNOSIS

Robert C. Kemp, *New York State Journal of Medicine*, February, 1905.

Kemp claims gastroduaphanoscöpy has proved of great value as an aid in diagnosis, and much has been written on this subject.

Milliot, in 1867, first succeeded in trans-illuminating the stomach of animals.

Einhorn, of New York, first successfully used the method on the living subject.

Kemp has found that filling the stomach with a fluorescent solution intensifies the illumination. Bisulphate of quinine, ten grains to the pint, gives a pale violet fluorescence, which is intensified by acids and destroyed by alkalis.

Fluorescein gives a green fluorescence. When employed in the stomach, the patient should first be given 18 ounces of water containing 15 grains of soda bicarbonate, then a second glass in which is dissolved 15 grains of soda bicarbonate, one dram of glycerine, and one-eighth to one-fourth of a grain of fluorescein. By this means the brilliancy of illumination is increased several times.

In performing transillumination the patient's stomach must be empty. The room must be dark. The patient sits during the introduction of the light, but stands during the examination.

The author has modified the Lock-

wood Gastrodiaphane by employing a more powerful light and by the addition of a flexible rubber guide cable, parallel to the conducting cable. By drawing on this cable and rotating the conducting cable the lamp may be made to explore the entire cavity of the stomach.

Transillumination absolutely differentiates dilatation from gastroptosis and enables the degree of dilatation to be estimated accurately. It permits exploration of the anterior wall, greater curvature, and pylorus for tumors, thickening, and stenosis. It differentiates carcinoma of the pylorus, small intestine, and liver. It determines marked distention of the gall bladder associated with dilatation of the stomach. It shows hour glass contraction and adhesions, and has proved an invaluable aid in the study of the etiology of mucus colic.

RADIOTHERAPY

SECOND NOTE RELATIVE TO THE MORE EFFICIENT UTILIZATION OF THE SPARK GAP RADIATIONS

Henry G. Piffard, *Medical News*, December 3, 1904.

Piffard ascertained the existence of what are called the Piffard rays by observations upon the radiance derived from his "ultra-violet" condenser spark-gap lamp, as follows:

"This lamp is furnished in front with a thin quartz plate which is transparent to ultra-violet rays, while glass is opaque to them. If the face of the lamp with the quartz in situ be applied to a piece of photographic paper (Solio) and the lamp actuated by a suitable coil, a strong impression will be made on paper in about thirty seconds. If the experiment be repeated with the quartz removed, the result is substantially the same.

"Ultra-violet rays, as is well known, will discharge an electroscope if charged negatively, but not if charged positively.

"On trial I found that the lamp with the quartz in front discharged the negative electroscope in about thirty seconds, but with the quartz removed discharged it instantly; that is, within less than one second. I found further that the radiations from the unobstructed spark would discharge an electroscope charged positively.

"It was clear from this that in addition to the ultra-violet rays we were dealing with another class of radiations that only slightly affected the photographic plate, but acted very energetically on the electroscope.

"In default of any means of determining the exact nature of these radiations I assumed that they were negative electrons and predicted that they would act very energetically on the skin or any other tissue with which they came in contact; and that the character of the reaction would resemble that from X-rays and radium, except that it would make its appearance more promptly."

The determination of the nature of these radiations has not yet been made, but their physical properties offer an interesting field for investigation. They are not deflectable by a magnetic field, hence cannot consist of negative electrons as do the beta rays of radium. They may possibly consist of positive electrons such as constitute the Goldstein rays, or the anode rays of the Crooke's tube, and the alpha rays of radium, none of which have heretofore been utilizable for therapeutic purposes. Piffard considers it more probable, however, that they are ions. These bodies are always developed at the site of an electric spark and coincidently an area of high pressure is created that drives the ions at a high velocity into the surrounding air.

Clinically, these radiations produce a reaction on the skin very similar to that provoked by the X-rays and radium, except that it appears more promptly. Like them also, their ultimate effect is curative or destructive according to the intensity and duration of the application. With a lamp in which the spark is produced between iron electrodes with one or more spark-gaps the total length of the gaps need not exceed one centimeter. An application of five minutes with such a lamp excited by a proper coil and condenser, will produce decided reaction in soft, morbid epithelial lesions. A similar application for fifteen minutes has resulted in the sloughing out of a lupus nodule, hence care should be used in the application. Clinical observation of these radiations shows that their influence extends much deeper than that of the ultra-violet rays, and a piece of velox paper exposed through a glass negative produced a fully-timed print in one one-hundredth of the time required to get one with a thirty-two candle power incandescent light. This action proves that these rays, while greatly inferior in volume to those from the incandescent lamp, very greatly surpass them in in-

tensity. The entire spectrum from red to violet is brilliantly illuminated during optical analysis.

The Piffard spark-gap lamp therefore furnishes three types of energy in combination. Intensely luminous and penetrating rays, ultra-violet rays, and a furious bombardment by ions; Piffard suggests the term triradial or triergic for such radiations. As regards technique he recommends as follows:

"(1) If the appliance should be used with a coil, a single Leyden jar should be employed, with inner armature connected with one of the secondary terminals, and the outer armature with the other terminal of the secondary of the coil. The lamp is then connected directly to the secondary by its cords. I prefer a Wehnelt interrupter adjusted to give a current of five to six amperes through the primary of the coil. The armatures should not exceed 40 square inches of foil in each. This is for the three-spark lamp. For the one-spark "ionizer" a lesser amount of energy is preferable.

"(2) If connected with a static machine use two Leyden jars the armatures of which should each have a foil surface of at least 100 square inches. The outer armatures of the jars should be connected together and the lamp terminals connected to the pole pieces of the static machine. The first application should not exceed 15 minutes with the spark from 15 to 20 millimeters from the lesion."

CATHODE RAYS AS SUBSTITUTES FOR ROENTGEN AND RADIUM RAYS

H. Strebel, *Dermatolog. Zeitschrift*, October, 1904.

The author states that the cathode rays which pass through the little aluminum windows exhibit a very strong physiological action which can compete

with or may even surpass the effect of the Roentgen and radium rays. The cathode rays after being absorbed by the skin produce an effect similar to that of radium and X-rays, and it has been proved that the cathode rays also follow the law laid down for radium and X-rays (by Kienboeck and Holzknecht) which says that the effect depends upon the quantity of the absorbed energy. The inflammation of the skin depends, just as after radiation with other rays, upon the time of exposure and the expended energy.

Therapeutically, the cathode rays seem to have more similarity with the radium than with the X-rays, so that they may be employed in place of the expensive radium.

THE PRESENT STATE OF ROENTGEN-THERAPY

W. Lehmann, N. Y., *Med. Monatschrift*, October, 1904.

The author gives an epitome of the progress the X-ray treatment has made since its beginning and presents several cases treated by him. A case of carcinoma of mammae which after being operated upon twice, after total extirpation of the whole left breast and removal of all enlarged glands in the axilla recurred and showed several tumors of the size of a walnut and several swollen glands. These were radiated for several months with the result that of the whole process nothing abnormal is left but a small gland in the axilla. A case of *ulcus rodens* on the forehead, which disappeared after four short radiations—soft tube; distance of tube eight inches, altogether 30 minutes exposures and several cases with small ulcers, all cured in a few seances.

Although the author favors using the X-ray in selected cases he does not consider it a panacea and advises, even in appropriate cases, not to regard it as the

only method of treatment. As Roentgen diagnosis is not the sole diagnostic means but only one of them, so radiotherapy is only one of our weapons, which at times must be combined with others.

ROENTGEN RAYS IN THE TREATMENT OF LEUKEMIA: A STUDY OF REPORTED CASES

George Dock, *American Medicine*, December 24, 1904.

To the list of agents that may reduce the number of leukocytes in leukemic blood must be added the Roentgen rays. Senn thought the Roentgen rays destroyed microbes whose relation to leukemia he did not doubt.

Heineke has reported a selective degenerative action of the Roentgen rays on the lymphoid elements of the spleen and other tissues, and has suggested the use of the Roentgen rays in such diseases as leukemia, pseudoleukemia, malignant lymphoma, enlarged thymus, etc., for that reason. Perthes, Sholz, and Exner had already shown that Roentgen rays cause irritant effects on connective tissue.

The author has studied the original reports of 29 cases. Colombo reported three cases with a primary fall of red cells and a rise of leukocytes, followed after prolonged treatment by a rise of the red corpuscles and a diminution of the leukocytes.

Acute cases may not be proper subjects for Roentgen treatment, but we have nothing better. Two acute cases died. Five chronic lymphatic cases showed marked improvement. In 11 cases under treatment the leukocytes fell to normal or nearly normal, as shown by the table:

Senn	.	.	64,000 to	normal
Brown	.	.	800,000 to	7,130
Bryant and Crane	.	.	176,000 to	4,500
Weber	.	.	328,000 to	7,200
Ahrens	.	.	1:1 to	1:525
Grosh and Stone	.	.	552,000 to	10,600

Evans (2)	. 250,000 to	12,600
Taylor	. 147,000 to	7,480
Eastman	. 1,110,000 to	normal
Chester	. 244,500 to	12,600
Fried	. 185,000 to	22,000

In seven cases the reduction was less marked, as follows:

Aubertin and Beau-		
jard	. 124,000 to	52,000
Krone	. 1:8 to	1:20
Dunn	. 128,000 to	37,000
Cheney	. 126,000 to	45,000-70,000
Evans	. 240,000 to	132,000
Capps and Smith	409,000 to	46,500
Fried	. 185,000 to	31,400

The differences in the results obtained may be supposed to be due to differences of dosage, that is, of intensity of treatment, or in the mode of administration, or to the earlier or later stage of the disease in which the treatment was instituted. Some of the patients were treated only over the spleen, others over the spleen, epiphyses of the long bones, and the sternum. None were treated over the long bones alone. The author has made some observations along this line with disappointing results. Good results have followed the treatment of the spleen alone. In many cases no special details are given. Exposures of 10 to 20 minutes were given as a rule every day, every other day, or less often. The duration of treatment was from 6 weeks to 6 months. Soft, medium, and hard tubes were used.

In a number of cases in which details of the blood examination were given myelocytes were still present at the end of treatment.

Aubertin and Beaujard were the only authors to make careful studies of the effect of the Roentgen ray treatment upon the leukocytes. They treated usually over the spleen for 18 minutes, using a tube with a vacuum corresponding to No. 6 on the Benoist Radiochromometer, or No. 5 on the Holtzknecht chromoradiometer at 25 cm. from the anticathode. They observed a rise in

the number of leucocytes beginning soon after treatment and reaching its height in about six hours, followed by a fall to lower than before. The changes were less marked in the latter seances. There was an increase in the polynuclears and a decrease in the myelocytes after each treatment. There were no differences in structure, no modification of the granulations, the degenerated cells or karyokinesis. The nucleated red cells did not vary appreciably. The authors thought the Roentgen ray caused the polynuclear cells to emigrate by some action on the myeloid tissue.

Several reporters state that improvement continued during temporary suspension of treatment, but Cheney noted an increase of leukocytes with cessation of treatment. The red cells usually increase.

The spleen and the lymphatic glands are usually reduced very much, but connective tissue overgrowth may prevent the spleen from returning to its original size. The general symptoms are usually improved. The patient may, however, die from toxic effects.

The mode of action of the X-ray is not known. At present the improvement must be considered functional and not effecting the original cause, nor in a permanent way the histology of the disease.

THE ROENTGEN RAYS IN THE TREATMENT OF TUBERCULOSIS

J. Rudis-Jicinsky, *American Medicine*, December 17, 1904.

The author was first led to believe that the Roentgen rays might be helpful in the treatment of tuberculosis pulmonalis by observing that a patient who was under prolonged fluoroscopic examination of the chest was relieved from the pains present after each examination. A series of twenty cases were treated at that time, four of whom entirely recovered apparently and are now useful mem-

bers of society, five years after the treatment was discontinued. He recommends the employment of fresh air, dietary regulation, and all other remedies which are useful in conjunction with the X-ray.

He considers that the ray acts beneficially through its power of breaking down pathological tissue, the molecules of which are more complex than those composing normal tissue, hence more susceptible of destruction.

For the treatment of superficial lesions, lupus, etc., he prefers a tube having a prolongation from the middle of the Roentgen ray field and made of lead glass, except at the end where the rays emanate, which portion must be of flint glass; this flint glass window is laid against the lesion. Such a tube would also be useful for applying the X-rays to the isolated areas in pulmonary tuberculosis. He favors the use of quinine sulphate in full doses in connection with the ray, and believes that better ray absorption through the tissues is thus secured.

Since December, 1902, he has had under treatment twenty selected cases of pulmonary tuberculosis. Five were of the hemorrhagic variety and showed improvement in ten weeks and are still doing well. Ten were fibroid cases, three of whom died after a lapse of six weeks. Two died with abdominal complications, one had tuberculous meningitis; four are slowly getting better and are at work. Three cases showing mixed infection discontinued treatment, but two persisted and are getting better. In six cases of acute tuberculosis of the peritoneum results are very promising; one of these six died, but all the others have recovered. In glandular tuberculosis he reports nineteen failures, eight cures, and six patients who were benefited; four are still under treatment and doing well. Sixteen cases of lupus vulgaris have been cured, in three cases failure obtained, and in tuberculous laryngitis only one case out of eight was benefited. Eight cases of simple tubercular synovitis were

cured in six weeks, four chronic cases benefited in four months.

In tuberculous bone lesions he never attempts to produce ankylosis by imposing complete rest and never puts the patient to bed. Treatment of such lesions by Roentgen rays not only gives promise of great usefulness but, as it does not necessitate confinement or other measures predisposing to general debility which favors the development of general tuberculosis, it exhibits advantages over other means of management.

THE TREATMENT OF LUPUS BY X-RAYS AND THE FINSSEN LAMP

F. H. Jacob, *Medical Electrology and Radiology*, November, 1904.

During the last three years Jacob has had under his management ninety cases of lupus, in the treatment of which he has relied to a greater or less extent upon the X-ray and Finsen light. His experience with these ninety cases has led him to believe that curative results are very much hastened by using accessory treatment, consisting of the application of either pure carbolic acid or pyrogallie acid before radiation is commenced. He applies the former as follows: "A small drop of pure phenol is placed on the center of the nodule and allowed to remain there until the surface is anæsthetised, by means of a pointed wooden match another drop is now introduced into the center of the nodule; this is readily allowed by the soft structure of the nodule. As soon as the deeper part is also anæsthetic the match is again introduced and the whole nodule destroyed; finally, the carbolic acid is thoroughly well rubbed into every crevice and burrow that can be found. If plenty of patience be exercised the whole process can be thoroughly carried out at the cost of very little pain."

Immediately after the carbolic acid has been used the Finsen light is applied

while the area treated is still white; in a week or less the surface is perfectly healed. Pyrogallic acid is used chiefly where the lesion consists of plaques of moderate size and for the margins of plaques of whatever size where the centers have undergone atrophy. It is employed in the form of an ointment or plaster, usually containing twenty grains to the ounce. When the application has produced pain serious enough to disturb the night's rest, the pyrogallic acid is replaced by a boric acid ointment.

These medicaments will remove the greater part of the gross visible lupus, but they will not remove the minute outlying nodules of microscopic size which are embedded in sound tissues and which form the foci from which extensions and recurrences take place. It is for the destruction of these outlying foci that X-rays and the Finsen light are valuable. The great advantage exhibited by the X-ray consists in the large area which can be treated at once; his treatment duration appears to be about fifteen minutes. The scar left after X-ray treatment is a very good one, but not, in Jacob's opinion, as good as that following the Finsen light treatment. The X-ray also will remove the subcutaneous thickening which sometimes occurs in the upper lip and in the leg, and for the removal of verrucose conditions. Its curative action also appears to persist for a longer time after its application has been discontinued, sometimes for several weeks. The principal disadvantage of the X-ray is that it sometimes produces telangiectases of considerable magnitude which are unsightly. He believes this result can be avoided by applying the ray for short periods at each seance or for long periods at long intervals, and that the result will be still further improved by following the course of X-ray treatments by a short course of the Finsen light.

The Finsen light produces a beautiful scar, but the slowness of its action is very

tedious. Small doses of the X-ray hasten the result markedly and diminish but slightly the beauty of the final result. The reaction which he prefers to produce consists of considerable swelling of the skin without blistering; the treatment is not repeated until this reaction has passed off, which is usually in about four days.

THERAPEUTIC EXPERIMENTS WITH RADIUM AND SENSITIZING SUBSTANCES

R. Pollard, *Wien. Klin. Woch.*, November 3, 1904.

The cases submitted to the treatment by radium were: One of *ulcus rodens*, one of *epithelioma*, one *cancroid* (*ulcus rodens*, *epithelioma*, and *cancroid* seem only different expressions for the same thing; the author's endeavor to use a new word every time is misleading and confusing), one *melanosarcoma*, two *naevi vasculosi*, two *haemangiomata cavernosa*, one *lupus vulgaris*. The cases were treated with a one per cent. solution of eosine in sterile physiologic salt solution.

The author's conclusions are:

1. Radium, in a manner analogous to that of the X-ray or concentrated sun or electric light, acts on the tissues as a destructive agent.

2. An elective effect on neoplastic tissue has not been observed.

3. A destruction of deeper-seated organs or tissues with a simultaneous preservation of superficial tissues does not take place.

4. The tissues continue to break down for a long time after cessation of the radiation.

5. Cavernous hemangiomata come to cicatrization by coagulation of blood on the radiated area and surrounding parts.

6. The destruction of large foci cannot be accomplished, because of the long

duration of the treatment necessary for a cure.

7. The effect of the radium seems to be inconstant and fluctuating, thus for the present excluding a reliable dosage.

B. 1. Intracutaneous injections of one per cent. eosine solution increase the absorbing power of the skin for direct sunlight.

2. Superficial ulcerations quickly improve under this treatment.

3. A safe and permanent destruction of all lupus tissue cannot be guaranteed, even with a long-continued treatment.

4. Any tonic phenomena, local or general, do not take place.

C. 1. By a previous eosine injection the efficiency of the radium is not augmented.

2. This fact may be explained by supposing that the radium rays are not analogous to the other known rays.

URANIUM SALTS IN CANCER

A. C. Wilson, *London Lancet*, February 11, 1905.

Wilson has previously suggested the internal administration of uranium salts for cancer and communicates the following case: A woman, aged 68 years, had had her right breast removed for cancer in July, 1902, at the Royal Infirmary, Liverpool. A year later inoperable re-

currence took place and she came under Dr. Wilson's care in May, 1904. At this time "there were countless nodules in the skin, varying in size from a pea to a marble, mostly in the axillary region, but extending forwards to the sternum and backwards to the spine on the right side of the chest." There was marked cachexia, decided dilatation of the heart, and the patient seemed doomed to early death.

She was put upon uranium salicylate (which seems to be better tolerated than either the nitrate or the acetate) 5 grains per day for the first few days, then for 6 months 15 grains, and for the next two months 20 grains. At this time "the health of the patient had much improved, . . . ; she eats and sleeps well, and for some months she has been able to do regular work as a seamstress. Locally dozens of the nodules have subsided and have become level with the skin, and though at intervals a fresh nodule does come the total area involved is much less than before treatment began." Nodules that disappeared first swelled, then became tender, and finally gradually faded away.

Wilson admits that this might have been a case which would have subsided spontaneously, but says that there was no evidence of such a tendency before the drug was tried and that if the patient suspends its ingestion for a few days she does not feel as well.

THERMOTHERAPY

HISTOLOGICAL CHANGES
BROUGHT ABOUT IN THE NASAL
MUCOUS MEMBRANE BY THE
APPLICATION OF THE GALVANO-
CAUTERY: A STUDY OF THE
PROCESS OF HEALING IN THE
MUCOUS MEMBRANE OF THE
NOSE AFTER A PORTION HAS
BEEN DESTROYED OR INJURED

Arthur Westerman, *Journal of Laryngology, Rhinology, and Otology*, London, England, February, 1905.

Ten cases are reported in which the inferior turbinate was cauterized and portions of the tissue excised for study of the histological effects produced. The technique of the experiment was as follows: "After anæsthetising the mucous membrane of the hypertrophied turbinate by means of a freshly prepared 10% solution of cocaine the flat or pointed cautery burner was applied to the diseased part, allowed to glow, and after

being sunk in sufficiently was gradually drawn from behind forwards. One or two such furrows were made. The depth to which the cauterization was carried was purposely altered in different patients in order that one might more closely distinguish and recognize to what extent the tissue was cauterized beyond the actual seat of application."

Portions of the tissues cauterized, including the bone itself, were excised for microscopical examination a few minutes, 24 hours, 48 hours, 72 hours, 96 hours, 7 days, 10 days, 16 days, 30 days, and 6 months after cauterization. The patients were all in good general health and varied in age from 9 to 46 years. The pathological conditions affecting them were rhinitis hypertrophica, and rhinitis hypertrophica vasomotorica.

Inflammatory reaction (leucocytic infiltration along the walls of the blood-vessels, and oedema) began to be manifest between the second and third days and reached its height on the fourth and

fifth day, when newly-formed epithelium became visible and the lesion was usually completely healed in about six weeks. The place of the destroyed tissue was first filled with granulations, which in time gave way to genuine scar tissue, and became covered with a thin layer of epithelium instead of the usual mucous membrane which was never regenerated at this place. Finally the turbinate was not only diminished in size and extent, but the liability to sudden changes in its volume, though alteration in the vascularity of the cavernous tissue (which was most profoundly affected of all) was also diminished. Thrombus formation was not encountered in any case.

Westerman believes, as a result of the actual effects observed upon the tissues treated, that "in many cases, especially when it is advisable to treat only a certain part of the turbinate, the galvanocautery is the best means at our disposal."

BOOK REVIEWS

X-RAYS: THEIR EMPLOYMENT IN CANCER AND OTHER DISEASES.

By Richard J. Cowen, L.R.C.S.I., L.R.C.P.I., etc. Member of the British Electro-Therapeutic Association. Author of "Electricity in Gynecology," "The Electrical Treatment of Menstrual Disorders," etc., etc. Pp. 129. Illustrations 10.

Henry J. Glaisher, London, 1904.

This is a handsomely gotten up little volume. The illustrations represent Tube Stand, Rheostat, Electrolytic and other Interrupters, specially wound Coil for working directly from Alternating Current Main, and Regulating Tube. There is very little about technic and apparatus, the author remarking that these subjects have been well covered in other works.

He has used the X-ray successfully in

the treatment of hypertrichosis, and as his opinion of its value differs from that of some other operators his technic should be noted. He uses a moderately hard tube to prevent too sudden or severe a reaction. At the first two sittings the anticathode is six or seven inches from the surface, later gradually brought to within four inches. Exposure six or seven minutes for two days in succession, then wait a week to watch for any idiosyncrasy. Then ten minutes exposures at six inches, two amperes of primary current at forty to fifty volts pressure and a rapid interrupter, daily sessions increasing the amperage to three. In most cases the patient may be sent away after ten treatments to await the appearance of a mild reaction, during which the hair will fall out. The re-

generated hairs must be destroyed by a second series of treatments begun three months later, and possibly a third series.

In treating lupus the X-ray has many advantages over the ultra-violet ray, but the percentage of cures is about the same. It is very necessary to produce a decided reaction.

Epithelioma presents a favorable field for X-ray treatment. Statistics show ninety per cent. of symptomatic cures in favorable cases, and the percentage of recurrences is less than after surgical removal. He uses a fairly hard tube and aims to produce a reaction in about ten sessions and then suspends treatment for a week or two. He thinks a surgeon should not operate on a case of epithelioma until X-ray treatment has limited the growth and destroyed any outlying glandular affection. A course of X-ray treatment begun immediately after an operation lessens the tendency to recurrence.

Carcinoma is a very different matter. He reports some favorable cases, one of mammary cancer treated daily for three months. A decided reaction should be induced in non-ulcerative cases, but less so in ulcerated ones. Pelvic carcinomata show temporary improvement and very great relief. Sarcomata of the neck practically invariably recur after operation, so that X-ray treatment from the earliest period is to be preferred to any surgical procedure.

A portion of the work is devoted to the X-ray treatment of skin diseases.

The book is attractively written and gives an accurate if not exhaustive view of the results of X-ray treatment.

RADIUM, ITS PREPARATION AND PROPERTIES. By Jaques Danne. Veit & Co., Leipzig, 1904.

The author, who is said to be one of the ablest assistants of Prof. Curie in Paris, was asked by the publishers to write a monograph on Radium to be pub-

lished in the German language. Outside of M. and Mme. Curie nobody could do that perhaps with more authority than Dr. Danne. After bringing a short history of the discovery of radium, Danne discusses the production of radium salts, their extraction, and their radiation. This chapter on radiation is important, as it gives a thorough explanation of the γ , β , and α rays of radium discovered by Rutherford. This is of great value to the physician experimenting along these lines. Equally so are the chapters on fluorescence and light effects, the physiological effects, the induced radio activity and the emanations.

The enumeration of all the literature excluding the medical concludes this interesting monograph.

LIGHT AS A THERAPEUTIC AGENT.

By Professor L. Brieger and Dr. Martin Mayer. Leonhard Simion Nf., Berlin, 1904.

Professor Brieger, who a few years ago received the appointment at the University of Berlin to follow up light therapy in every direction, has written the above review with the assistance of Dr. Martin Mayer. In the introduction the authors regret, and we agree with them, that this branch of medical therapeutics has for years been exclusively in the hands of quacks. Things have changed now, and names like Gebhard, Schoenenberger, Finsen, Rieder, Frankenhäuser, and of late Dreyer, Neisser, and Halberstaedter are proof enough that the treatment with the electric light has been placed on a scientific basis.

The student of this branch of radiology will find nothing that would be new to him, the authors even carefully avoiding any discussion about disputed points. But whoever wants to be informed quickly, and we may add, superficially, will find in this book what he is looking for.

**LIGHT ENERGY, ITS PHYSICS,
PHYSIOLOGICAL ACTION, AND
THERAPEUTIC APPLICATION.**

By Margaret A. Cleaves. Rebman Company, New York and London, 1904.

This is a large work, filling 827 full pages. When one looks at the mass of material collected, one is really surprised how much work has been done in a comparatively short time by the different authors of the world. Dr. Cleaves is one of these authors and we went with great expectations on the study of her work.

In the first chapter C. describes the different rays of light in general. Not only those of the sun and an electric light are discussed, but also the X and N, as well as the Cathode rays. Then follows the chapter on the physics of light energy. Here 110 pages are filled with what could well be said on about 50 or less. All those elementary facts on the one hand and the mass of technicalities on the other are not written for physicians. While it is wise to give the reader an explanation of the physics of light in order to enable him to better understand the laws governing its application in medicine, such long lectures are, to say the least, unnecessary.

More satisfactory and more to the taste of the physician are the following chapters on: The action of light energy upon elementary forms of life, upon vegetable organisms, and upon bacteria. In the succeeding chapters which are the most important in the book, we miss the name of Willibald Gebhard, who was the first one to write a very valuable work on that topic. This author is mentioned only once in a by-way, while the works of Freund on the one hand, and Leredde and Pautrier are quoted entirely too often for any original handbook.

Sun baths and electric arc baths are dealt with in a very satisfactory way. We heartily endorse a sentence like the following: "There are comparatively few sick rooms, taking the country as a whole, which can not be converted into a

comfortable sun room at some time between the hours of 9 A.M. and 3 P.M., when the sun's energy is most effective." It would be a benefit to humanity, if physicians would not forget the value of these words for any sick room, indeed for any room.

The views of Cleaves in regard to the therapeutic benefit of these rays are rather optimistic. But we decidedly prefer them to the opinion of those men who, without any practical experience and knowledge, deny that there is any therapeutic value to these rays.

In the other parts of the book a good deal of useful material is given, which will interest the reader. We can recommend the book of Dr. Cleaves as a whole, although we wish that in a future edition it may be shortened materially.

GUIDE TO ROENTGOGRAPHY. Edited by Ing. Friedrich Dessauer and Dr. Med. B. Wiesner. Vogel and Kreienbrink, Berlin, 1904.

This handbook is a good compilation of our present knowledge of the X-rays, and indeed it includes some remarkable articles. The first one is an issue on the physical laws governing the Roentgen rays, written by one of the editors, Friedrich Dessauer. It shares the advantages and disadvantages of many German textbooks. While it is written with an exceptional knowledge of the theme, the occasional reader of such scientific papers will find it hard to work his way through these technicalities. Even the one familiar with this branch will occasionally encounter such difficulties. This is partly also the case with the second part, written by Kraft and Dessauer, on "Technical Hints in the Working of X-rays." Of interest are the chapters on "Orthodiagraphy," by A. Hoffman, on "Stereoscopy" by Hildebrand, on "Portable Roentgen Apparatuses" by Metzner, and finally on the "Roentgen Rays in Surgery" by Hoffa and Blenke.

ELECTRODIAGNOSIS AND ELECTROTHERAPY. By Dr. Ludwig Mann, Breslau. XXV and 161 pages. Cloth M., \$2.80 (70 cuts). Alfred Hoelder, Vienna, Publisher.

This is the 9th volume of Medizinische Handbibliothek (medical hand-library), which is somewhat similar to the series of quiz compend-series. Dr. Ludwig Mann is well known as the author of electricity and electro-therapeutics in Goldscheider and Jacob's big handbook of physical therapy. The present little book comprises everything pertaining to electrodiagnosis and electrotherapy which ought to be known by the busy practitioner.

The bulk of the book is devoted to the faradic and galvanic currents and these chapters, although not exhaustive, are very good and useful, and that on the reaction of degeneration deserves especial mention. The book consists of a larger general part and a smaller special part. The general part treats of the induction or faradic current (28 pages); the galvanic or constant current (51 pages); the combined or galvano-faradic current; the employment as furnished by the dynamo machine (direct, alternating, sinusoidal, indulatory, three-phase current); condenser discharge: the static or franklinic current; the high frequency high tension currents; the monodic volta current; electromagnetic therapy; the hydroelectric bath; electrolysis, cataphoresis, and galvanocaustics.

The special part treats of diseases of the nervous system; the muscles, the joints, the bones, the special sense organs, the heart and blood vessels, the lungs (including the upper air passages), diseases of stomach and intestines; of the genito-urinary tract, skin diseases, febrile diseases, and diseases of metabolism. An appendix gives electrodiagnostic points and the values of faradic and galvanic irritability.

1. We like to call attention to several

statements with which we cannot coincide. Mann says several times that the faradic current is less penetrating than the galvanic, thereby confounding voltage and amperage. He does not state how often the Wagner hammer must be interrupted to give a certain effect and he also entirely omits to mention the faradic high tension coil. The author's statement that the enuresis nocturna of children is mostly a hysterical symptom is open to criticism.

CLINICAL RECORDS OF LIGHT AND X-RAY THERAPY. By G. G. Stopford Taylor. John Bale, Sons, and Danielson, Ltd., London, England.

This little book of 50 pages is a pictorial record of the result of a considerable experience in X-ray and Finsen light therapy. The text consists practically of a series of case reports, most of which are illustrated by full cabinet plates before and after treatment. A description of the various forms of substitute Finsen lights is given, and attention forcibly called to the *fact* that most of the failures following the use of these small lamps result from neglect to render the part treated anæmic by forcible pressure. The author, being a dermatologist, affirms that excision is the most suitable treatment for rodent ulcer and epithelial cancer except when recurrent or when attacking the eyelids. Five cases of rodent ulcer are reported and illustrated. Two cases of lupus are reported cured. The author has not succeeded in curing *any* case of epithelioma, but has observed some benefit from X-ray. A few good cases of acne are shown. There is no attempt at a description of the technic, but in view of the result this is not a serious loss.

As an advertisement of the author, the book is a distinct success; as a contribution to scientific X-ray literature it is not to be considered.

NEW APPARATUS

THE OVINGTON ELECTRO-THERAPEUTIC AND HIGH FREQUENCY APPARATUS

This apparatus is a further development of the Strong-Ovington static induction and high frequency apparatus. It is designed chiefly for the production of high frequency currents by both the d'Arsonval and Tesla methods, but is also efficient for the generation of powerful X-rays and superlative ultra-violet radiations. Among the new modalities obtainable from this apparatus and not supplied by the Strong-Ovington machine, in addition to the d'Arsonval current, may be mentioned the sinusoidal current, cautery and diagnostic light currents, and a new modality discovered by Mr. Earle L. Ovington, which he has aptly named the superimposed sinusoidal current. This differs from the ordinary sinusoidal current in having each sine wave broken up by a number of shorter oscillations caused by the superimposing of a high frequency current upon the sinusoidal current. This current has a marked effect and will probably find a place in electro-therapeutic practice.

The new apparatus also embodies improvements in design and construction,

including a new method of regulation, which permits of the production of effects very similar to those obtained from static machines, resonators, etc., and includes the most delicate as well as the most powerful effects. A spark very similar to the ordinary static spark can be obtained for the production of muscular contraction through application to motor points. The new regulator makes possible the utilization of both monopolar and bipolar effects for the production of the spray or in other methods of treatment.

This apparatus is claimed to have a wide range of frequencies, including one much higher than the frequency obtained from the ordinary resonator; a relatively high amperage in the Tesla circuit with a high potential; perfect balancing or tuning for resonance and increased efficiency throughout the apparatus. It is also claimed to be unparalleled for the production of the dynamic effects shown by Freund to be obtainable by the application of high frequency current of high potential and great amperage. It is for sale by Mr. J. Emory Clappl, Colonial Building, Boston, Mass.

Plates Illustrating
Pott's Fracture; Fractures of
Tibia and Fibula; Sarcoma
of Tibia; Dislocation
of Hip

The Archives of Physiological Therapy
April, 1905



Pott's Fracture, sustained in a railroad wreck, skiagraphed four months after injury. Plaster cast treatment. The joint is useless and ascending neuritis present. Swelling was so great that diagnosis by ordinary means was out of the question. Upon the strength of this skiagraph patient secured damages for \$3,800.00 without question.

Exposure 10 seconds. Anode 20 inches from plate. Water cooling tube. 30 inch coil. Hydrochinon developer.

By Dr. Gordon G. Burdick, Chicago, Illinois.



Fracture of Tibia and Fibula, taken one year after injury, and illustrating the fallacy of the plaster cast treatment for fractures. The fracture was treated by an eminent surgeon who does not believe in the X-ray; claims that it is unreliable.

*Exposure 5 seconds. Anode 20 inches from plate.
30 inch coil. Regulating Tube. Hydrochinon developer.
By Dr. Gordon G. Burdick, Chicago, Illinois.*



Same subject as Plate VIII. Lateral view.

Exposure 5 seconds. Anode 20 inches from plate. 30 inch coil. Regulating tube. Hydrochinon developer.

By Dr. Gordon G. Burdick, Chicago, Illinois.



Sarcoma of Tibia with Tubercular Myelitis.
Diagnosis confirmed by operation, which was followed by multiple sarcomata in various parts of the body.

Exposure 5 seconds. Anode 20 inches from plate. 22 inch coil. Light tube. Hydrochinon developer.

By Dr. Gordon G. Burdick, Chicago, Illinois.



Supposed Dislocation of the Hip. Boy of 6 years. Plate shows arrested development of femur, ilium, ischium, and pubis.

Queen coil. Water cooled tube. Wehnelt interrupter. Pyro developer. Cramer X-ray plate. 15 seconds exposure.

G. C. Johnston, Pittsburg, Pennsylvania.

By Dr. G. C. Johnston, Pittsburg, Pennsylvania.



Dislocation of the Hip. Reduced by Lorenz method. Plate taken through plaster cast.

Fifteen inch Queen coil. Wehnelt interrupter. Bario-vacuum water-cooled tube. Exposure 30 seconds. Pyro developer.

By Dr. G. C. Johnston, Pittsburg, Pennsylvania.



Congenital Dislocation of the Hip. Age 4 years. Female. Radiograph shows vulva and urethra.

Exposure 15 seconds. 15 inch Queen coil. Wehnelt interrupter. Gundelach tube. Pyro developer. Cramer X-ray plate.

By Dr. G. C. Johnston, Pittsburg, Pennsylvania.



THE ARCHIVES OF PHYSIOLOGICAL THERAPY

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VOLUME ONE

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NUMBER THREE

STATIC ELECTRICITY IN CHRONIC NEPHRITIS; A RECAPITULATION*

BY C. S. NEISWANGER, M.D., OF CHICAGO, ILLINOIS

Professor of Electro-therapeutics, Chicago Post Graduate Medical School and Illinois Medical College; President and Professor of General Electro-therapeutics Illinois School of Electro-therapeutics.

ORIGINAL investigation, especially upon medical subjects, and where the results are almost phenomenal, is almost necessarily fatal to the finances and reputation of the investigator unless he be spared long enough to gain the company of sufficient support to strengthen his position.

The above subject, although not originally selected for this meeting, has been again chosen, partly at the request of friends, and we feel the more encouraged to do so because other physicians—notably Reed of Philadelphia and Hurd of Minneapolis—have in recent articles upon the subject reiterated the writer's views.

* Read before the Electro-Therapeutical Section of the International Electrical Congress held at St. Louis, Mo., September 12-17, 1904.

How prone is the physician to criticise adversely the things that are new, and how inexplicable is human nature in general in this respect. The writer was forcibly reminded of this seemingly innate characteristic of all mankind when, eight years ago, he had the temerity to attack the old, accepted pathology of a recognized incurable lesion—chronic Bright's disease. And how nearly fatal it proved to his medical aspirations until, by persistent and extended clinical work, the dark clouds of adverse criticism are being replaced by the sunshine of honest investigation. Many letters are constantly being received stating the experience of other physicians in this direction and going further to prove the views of the writer.

It is not deemed advisable at this time to consider either the etiology, pathology or diagnosis of the disease under

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discussion, and only such pertinent points in the treatment will be given as will enable the physician to apply it intelligently. These are omitted, first, because the old are well known to every physician present, and the newer views of the writer have been almost constantly before the medical profession since their inception eight years ago; second, because they are not considered essential for the purpose of this paper, which is only a recapitulation.

A few points, although contained in former literature upon this subject, may be mentioned here merely as reminders:

That chronic nephritis is more essentially a disease of central nervous impairment.

That one of the strongest proofs of this is the kind of persons afflicted.

That the natural paths along which impressions are conveyed to the kidneys are through the splanchnics and spinal cord; and, when these tracts are impaired, the function of the kidney is correspondingly affected.

That the results of decapsulation show it not to have a place in the successful treatment of this disease, and that other operative procedures have been equally barren of results.

That the reduction of albumen obtained by strict diet has no clinical significance.

That the remedy indicated is one that will hasten the oxidation of waste products.

That static electricity is the logical remedy, because, by the evolution of oxygen, always accompanying this modality, not only hastens the elimination of waste matter, but gives a better tone to the nerve centers affected by its vibratory action.

That static electricity is a powerful equalizer of the nervous forces, as is evidenced by its effect on the temperature, respiration and pulse.

That in all cases of chronic nephritis treated by the writer, where there was

mitral regurgitation or the hypertrophy which precedes it, the results have been almost entirely negative.

It was the intention to present at this meeting the reports of twenty consecutive cases, in which the diagnosis was made by experts, but on account of the length and similarity of these reports it is only deemed advisable to present a summary of the twenty cases, as follows:

Permanently relieved . . 12 or 60%

Partially relieved 2 or 10%

Failures 6 or 30%

The two cases that were partially relieved were still taking treatment and showing some improvement, but were finally lost sight of.

Although the results in 30 per cent. were finally negative, two of the cases were so materially benefited after one month treatment that they were provisionally discharged. Both returned after the lapse of one year as bad as when first seen, and were not benefited by subsequent treatment.

In all the unfavorable cases the heart's action was characteristic of the advanced stage of the disease. Two had passed the age of 70, one was only 15.

Longest time between the discovery of the disease and presentation for treatment in all the cases was six years.

Of the twenty cases seventeen were males, three females.

Five were physicians; four board of trade operators; three preachers; two housewives; one domestic; two traveling salesmen; one clerk in city hall; one jeweler; one laborer.

The treatment used has been the negative head breeze for 15 minutes, followed by positive insulation for the same length of time. The Morton wave current is alternately substituted for the head breeze. Treatments are given daily. After a few sittings the urea commences to increase, carbon dioxide is eliminated and albumin and casts decrease. The patient has a feeling of

well-being, sleeps well and is free from pain.

If the results as stated in this paper serve to stimulate more extended research in this direction, the writer will

feel amply repaid, and also be pleased to give more extended details—to any of the profession—than could be brought out in this paper.

THE THERAPEUTIC APPLICATION OF THE CONTINUOUS CURRENT*

BY TRUMAN ABEL PEASE, M.D., OF NORWOOD, N. Y.

AN age can hardly be called an Electrical Age if in it electricity is limited to the moving of wheels and sound and light. When men manipulate all matter not by crude mechanical means but by the direct application of electricity—then we shall be able to say, This is an Electrical Age!

The electrical Age is even at our doors, and as physicians we may lead the way in the varied application of this divine power as old as the ages and as little understood by the many.

To become efficient in this department one should be enthusiastic in the development and application of the various currents used in Electro-Therapeutics, viz: The Continuous, The Faradic, The Sinusoidal and the almost innumerable Static Modalities.

To make any vapor do our work we surround it by a stronger case. To utilize the power of a stream of running water we direct its course by a dam of greater strength. Likewise the work accomplished by any of the various currents of electricity is ever the result of a rapidly moving stream of material

atoms controlled and directed by a greater resistance. Every separate atom found in any elementary body is composed of a definite and constant volume of negative electrons working in a corresponding mass of positive electricity. The nature of the elementary body, i. e., the valency or number of that element, depends upon the number of ions in the atoms. The manner of the work done by electrical currents depends in a large degree upon the composition of the electrode or electrolytes as well as upon the rate of vibrations.

Of all agents used in the treatment of diseased conditions, none fills a wider field of usefulness than The Continuous Current. In surgery it may be used for the removal of the smallest blemish that mars the beauty of any fair face, while the largest neoplasm often yields to its persistent application.

Of the action of the Continuous Current applied for the disintegration of abnormal and effete matter and its removal from the body by sentient matter through selected inherent power of its own, the following case will serve to illustrate:

Some twenty years ago the writer was called to treat a painful exostosis of the tibia. The tumor was about as large as a butternut and as firm and dense as any other part of the bone. It was very painful. After the application of many

* Read at the Fourteenth Annual Convention of the American Electro-Therapeutic Association at St. Louis, Mo., September 13-16, 1904, and published in this journal by special permission of the author and the Executive Council of the Association.

remedies and the application of iodine by phoresis the pain and irritability were much relieved, while the size and density of the tumor remained the same. At the end of four years after a successful treatment of a gangrenous abscess involving the middle lobe of the right lung with the hydrogen dioxide it occurred to the writer to try the same agent by cataphoresis upon the exostosis of the tibia of four years standing. After contriving a cup electrode of a cambric needle, some sealing wax and a piece of glass tubing he filled the cup with hydrogen dioxide and placed it upon the tumor in such a way that the point of the needle came in contact with the skin. Connecting this electrode with the negative pole of the battery and applying to the opposite side of the limb a large electrode made of a piece of wire gauze with a binding-post soldered to its center covered with moist absorbent cotton, to which he attached the positive pole of the battery. A continuous current of 10 milliamperes from a Macintosh battery of 12 cells was slowly turned on. At once a mass of white matter began to pile up about the point of the needle after the current ran for 15 minutes, when the mass was as large as a large pea. After 12 treatments on alternate days the growth disappeared entirely, leaving the bone in a normal condition.

Much of the pain and suffering and especially a very large share of the protracted nervous conditions that prostrate the patient and wear upon the attendant are either directly or indirectly the result of stenosis. This may be avoided or remedied, if one relies upon electricity for clearing the channels, whether large or so small as not to be discovered until the organs that depend upon a clear and free right of way through them to be healthy become congested, infiltrated and engorged by effete and useless matter.

In the treatment by phoresis an intimate knowledge of anatomy and physi-

ology is most essential—having not only a knowledge of the various organs involved, but being also a percipient of the pathological conditions that appear.

Case I.—Was called to see Miss I. B., aged 19, on the first of August, 1891. I found her in bed, where she had been for seven months as helpless as a new-born infant. She was extremely emaciated and anæmic—weighing 75 pounds, pulse 120, temperature varying from 99 to 102. She had not sufficient strength to raise her head from the pillow. When placed in an upright position in a chair her head would fall whichever way it was moved one inch from the center of gravity. There were four adenoid growths on one side of the neck and five on the other, varying in size from that of a hazelnut to an English walnut. Her bowels were very irregular—moving once in two to six days. On one occasion her mother told me there were thirteen days between stools. For weeks she had had convulsions after every stool. After making a careful physical examination I pronounced the case one of hysterical neurasthenia, resulting from obstinate constipation and intestinal engorgement. I proposed treatment by saline phoresis. Her friends said that the case had been diagnosed as one of organic brain and cord lesion—a case in which it would be very dangerous to use electricity. But upon my assurance that there was no evidence of organic disease they consented to the treatment. I began treatment by intestinal saline phoresis. Placing a large positive electrode covered with moistened absorbent cotton upon the abdomen I carefully introduced a perforated rubber tube containing a spiral metallic electrode into the colon. To the tube was attached an ordinary fountain syringe containing a normal saline solution. The valve was opened and a current of five or ten milliamperes was turned on and allowed to remain 20 minutes, or until two quarts of the

solution had slowly percolated into the bowel. When the current was slowly turned off a secondary faradic current was applied for a few minutes. After 20 minutes there was a small evacuation of hardened feces covered with bloody mucus. The stool was followed by the usual convulsion, which lasted 20 minutes. I continued the treatment on alternate days for one week. After the third treatment there were no more convulsions. The treatment was continued twice a week for the following two weeks, after which I gave her only one treatment per week for five months. She was then discharged entirely cured and weighing 140 pounds, her neck as smooth as at any time in her life. She has remained in perfect health since.

Case II. — One of neuritis, involving the median, ulnar, and musculo-spiral nerves of the right shoulder and arm, resulting from cervical stenosis — cured by saline and mercuric phoresis.

Mrs. F. B., aged 42 years, came to my office the 6th day of May, 1902, suffering intensely from a severe attack of neuritis that involved all the nerves of the right side of the neck, right arm, fore-arm and hand. The nerves and adjacent tissue were swollen, hyperæmic and hyperæsthetic, so painful that they could be handled only with the greatest care. When they were touched she would cry out like a child when in the severest pain. The hand and arm were carefully held in a horizontal position, the fingers being flexed at right angles. Some of the muscles of the hand, especially the adductors of the thumb, were atrophied. The case had been under treatment for six weeks without any permanent relief when I began treatment with static electricity, using sparks, breezes with wave and high frequency currents. There was marked relief from pain and nervous suffering that was only temporary, the pain and insomnia returning on the second day after the treatment. On examination

of the cervix uteri I found that a very small sound could not be passed. After the application of a solution of cocaine and adrenaline by cataphoresis I succeeded in passing a small copper electrode, turned on the current, using 5 to 10 milliamperes for five minutes. My patient then exclaimed, "Why, Doctor, my arm aches much worse!" I replied, "That confirms my diagnosis." Ten minutes after the positive current had been turned on to the electrode in the cervix she exclaimed, "There is no pain at all in either shoulder or arm!" I replied, "That confirms my treatment." At the end of five weeks she returned home and was able to use the arm and to sleep well every night. She has remained in perfect health, with no return of the neuritis.

Case III. — Mr. H. B. H., a granger, aged — mark the age — 83 years. He suffered intensely from prostatitis and stricture of the urethra at two points where I found ulceration. The urethra was so sensitive and sore as to make the evacuation of the bladder with a small catheter that he used himself so painful and difficult that, to use his own language, he had given up the case as a hopeless one. He came that I "might care for him to the end, which could not be more than two or three weeks at the most." After the cataphoric application of a solution of adrenaline and cocaine upon a small cotton-covered sound I used a number 9 catheter with so little difficulty and pain that he said, "I would not have believed it possible had I not personally experienced it." Upon my assurance that he would be able to return to his home a well man in three or four weeks he replied, "You cannot do that, Doctor, in spite of your confidence in your new methods." I began treatment of this case on the 30th day of June, 1902, using a normal saline solution at first by phoresis, after which I used a solution of resorcin, followed by a solution of protargal applied to the bladder

and urethra by phoresis, always using a rheostat and milliampere meter in the circuit and never allowing the meter to show more than 10 milliamperes. He returned home on the 29th day of July, 1902, in excellent health. He is well and at the present time he is able to attend to all the duties devolving upon one in his walk of life.

Case IV.—Mrs. C., aged 29 years. Mother of two children. Came to me from a sanitarium, where she had been under preparatory treatment for three weeks for the removal of a tumor and where she had a severe hemorrhage of the bowels, lasting 36 hours, which completely prostrated her. Upon examination, I found the uterus, both the ovaries and the rectum in a mass of plastic tissue, so irritable and sore as to make a thorough examination very difficult. The use of a small flexible sound in either passage was followed by free hemorrhage, which was controlled by the cataphoric action of adrenalin. I then began treatment by saline phoresis, followed by mercuric cataphoresis, never using more than 10 milliamperes. After four treatments, in which I applied cocaine, adrenalin, and saline phoresis there was no further trouble on account of hemorrhage. The mass began to disintegrate and the pelvic organs were restored to their normal condition and proportions. The patient has so far recovered as to return to her household duties. She is still my patient.

Case V.—Mrs. E. W., aged 36. Mother of two children. I found her in bed with symptoms characteristic of enteric fever. Pulse 110, temperature 104° F. The abdomen, tense and sore and very sensitive to the slightest pressure. She had irregular paroxysms of pain, and there had been extreme tenderness in the left iliac fossa. On making

a vaginal examination I found all the pelvic organs prolapsed and adherent to the pelvic walls, forming a large mass having a doughy feeling. The uterus was retroflexed and immovable. There was a constant discharge of dark, bloody matter and a very offensive odor. A straight sound would not pass into the body of the uterus, but upon bending it at a right angle the point passed very easily in a posterior direction about three inches and a half, showing that portion of the tumor to be made up of the enlarged body of the uterus, while the opposite half of the tumor seemed to contain the left ovary and tube, being so firmly fixed to the walls of the pelvis as to make the whole mass immovable and to prevent the use of the speculum. The os was so low down as to be seen without the use of any instrument. After reducing the fever and rendering the local condition as nearly aseptic as possible, I began the cataphoric use of iodine, thapsia and aconite. After four treatments, which were given on alternate days, the fever and hemorrhage were entirely controlled. Then I began treatment by mercuric phoresis, which restored the uterus and appendages to their normal condition. She was under treatment at her home for one month, when I was able to place all the organs in a nearly normal position, supported by tampons saturated with ichtholmen, when she was able to resume her household duties and come to the office for treatment two or three times a week for three months.

What can be more satisfactory to the earnest physician than the gratitude of the patient whom he has healed by a method which patients appreciate—a method painless, and free from the horror of the knife and the mutilation?

A CASE OF HYPERIDROSIS AXILLAE TREATED BY X-RAYS*

BY G. H. STOVER, M.D., OF DENVER, COLORADO

THE anatomical changes found in hyperidrosis are not striking; often no structural change at all can be found in the skin, showing that in many of these cases it is purely a functional disease.

In Schmidt's report of a case of dermatitis atrophicans, due to prolonged exposure to the X-ray, the statement is made that the sweat glands were not affected; Pusey says that histological examination shows atrophy of the sweat glands as a result of X-ray exposure.

The patient, No. 108, of whom I speak, a young married woman, is one of the most extraordinary examples of axillary hyperidrosis on record, I think. A dermatologist in New York who saw her some years ago stated that an English patient whose disease was no worse than hers, had discharged two quarts of axillary perspiration per day, by measurement. I can well believe this, for in the dry atmosphere of Colorado my patient required many changes of clothing every day; all the layers of clothing beneath her arms clear to the waist and for a space of six to eight inches wide would be dripping and the sleeves from shoulder to elbow saturated in a short time after dressing; even while sitting quietly in the evening at the theatre or elsewhere this was the case. This had gone on for years in spite of many forms of treatment, including in-

ternal medication, external applications, and even a large number of painful drug-injections into the skin of the axillæ. Her life was rendered miserable by the affliction and she was becoming neurasthenic in her despair following years of fruitless experiment.

She was very willing to give the X-ray a trial; though I stated to her that I knew of no similar cases having been treated by this agent and could promise her nothing, yet I believed there was good reason for making the attempt.

I used a Rhumkorff coil giving a six-inch spark, operated by an accumulator of ten volts, core drawing five amperes, hammer interrupter, a low tube at a distance of four inches from the skin, exposing each axilla on alternate days for a period of ten minutes; I always wiped the axilla dry before beginning the exposure. After the tenth exposure the skin began to show some pigmentation; after the twenty-fourth exposure there was a slight erythema which never amounted to more than a mere blush; at the thirty-first exposure my notes state that the perspiration is distinctly less; at the thirty-eighth exposure the improvement was very great; at the forty-fifth exposure, the hair, which had come out somewhat already, was falling rapidly; at no time during the treatment did the hair become gray or white as has been mentioned by some; after the forty-eighth exposure she went to Cuba on a pleasure trip; at that time she was perspiring very little indeed.

While in Cuba, she, in company with others of the party, danced the two-step at the request of the orchestra leader, who had never seen it; this was fol-

* Read at the Fourteenth Annual Meeting of the American Electro-Therapeutic Association at St. Louis, Mo., September 13-16, 1904, and published in this journal by special permission of the author and the Executive Council of the Association.

lowed by other dances; the temperature of the ball-room was 94 degrees F., yet she perspired almost none.

Four months after this she consulted me, as I had told her that further exposures would undoubtedly be needed; the axillary hair had returned and she was perspiring but little more, if any, than the average woman.

I made twelve exposures on succeeding days, the first two being of fifteen minutes duration, the technique in the others being as in the former series of treatments; after the eighth exposure the pigmentation appeared and the hair fell again; there was some erythema at the end of the series, and perspiration had stopped entirely.

EDITORIAL

RADIUM IN THERAPEUTICS

THE discovery of this wonderful element has had such a profound influence upon physical thought that, for a time, it threatened to wreck the whole structure of physical law which it had required years of labor to erect. The story of its discovery has oft been related, but constitutes such a triumph for analytical scientific methods that we turn to it with vivid interest every time it is presented.

The mention of radium at once brings to mind the name of Madam Curie, whose brilliant, monumental investigations resulted in placing the substance at the command of physicists. The fact that Becquerel's work led to her conception of the fact that such a body might exist and started her upon the quest for it, does not detract in the least from the credit due her, and as long as physical laws are taught the name of this able woman will be honored as that of one whose work was epoch-making; marking and creating a point whereat was inaugurated the destruction of time-worn fallacies and a further dissemination of the light of scientific truth.

She had long been impressed by the fact that pitch-blende, composed mainly of thorium and uranium, gave off rays similar to those described by Becquerel, and after having separated the uranium from the mass she found that the remainder was very much more radio-active than the uranium which she had separated therefrom. Her husband, Professor Curie, became interested about this time, and together they analysed this remaining mass by tedious methods, each time selecting that portion which was more radio-active than the preceding, until finally they obtained an intensely radio-active body, in the form of a chloride, to which they gave the name Radium.

The pure element has not yet been isolated, but the atomic mass was determined by Madam Curie as 225, showing it to be one of the heaviest elements known, and locating it in the group with calcium, thorium, and barium in compliance with the periodic law.

About one-tenth of a grain of radium is obtained from about two tons of pitch-blende after much repeated precipitation, filtering, and crystallization, making the cost of even a very small quantity almost

prohibitive. The radium of commerce, at present, is in the form of a bromide and occurs in small white crystals, very soluble in water, resembling the barium salts very closely in its chemical properties, giving a characteristic spectrum, and imparting a crimson color to the Bunsen flame. It gives off heat continuously, fifteen grains being capable of raising the temperature of the air in its immediate neighborhood about three degrees centigrade.

Radium gives off three kinds of rays called the alpha, beta, and gamma rays. The " α " rays are very fine particles of matter, travel at about one-third the velocity of light, carry positive charges of electricity, exhibit very little penetrative power, and are deflected toward the negative pole of the magnet.

The " β " rays are the true "corpuscles," invariably carry a negative charge, are repelled by the negative pole of the magnet and attracted by the positive. They travel with varying speeds probably somewhat less than the velocity of light, will penetrate human tissue to a depth of about one-half inch, and are considered by many to be similar to the cathode rays. They give rise to X-rays when arrested or deflected by a solid body. These are the valuable rays therapeutically, and it is by reason of their action that destruction of tissue takes place.

The " γ " rays are not particles of matter at all, but electro-magnetic pulses in the surrounding medium (ether). They resemble the rays from a hard Crooke's tube and are very penetrating, being capable of passing through about two inches of iron. Bone offers practically no resistance to these rays, they do

not discharge an electroscope, are not deflected by magnetic lines of force, and are of value therapeutically for their stimulating effect upon the cells of the human body.

It is worthy of note that physicians were about the first patrons of the Curies, paying the price demanded without demur, in the hope that the active element would be found useful in the treatment of disease.

The early records of observers were so optimistic that the profession, with its proverbial conservatism, was rather inclined to doubt their reliability, and as more operators came into the field, the reports became even more conflicting, until determining what to believe and what not to believe became a most difficult problem. Analysis shows that the cause of many of these discrepancies was to be found in the fact that the first radium was purchased by X-ray operators, who had had several years experience with radio-therapy, and had gained some knowledge of the appropriate methods of handling the particular class of cases in which radium would be likely to prove useful; these men had also learned the necessity of judiciously selecting cases that promised amenability to radio-therapeutic procedures. They were followed later by men who depended solely upon literature for their technic, who, not having the requisite knowledge or facilities for testing their radium were obliged to depend upon the honesty of the salesmen, and were sometimes victimized by having had sulphide of calcium palmed off upon them as radium; it is not strange, therefore, that bad or indifferent results followed their efforts.

Some good results have been secured, and it seems to be the unanimous opinion of X-ray workers who have used radium that its effects are identical with those of the X-ray, only incommensurably weaker, but that this may be compensated for in some degree by the possibility of placing radium in close contact with the disease. Considerable advantages exhibited by radium are, that it can be conveniently used in the body cavities, that the rays can be made to travel in any desired direction, and that the radiance is uniform in strength. It would seem that it might be useful when applied in combination with other radio-therapeutic measures.

As to the physiological action of the radiance from radium, it is known that it exercises a pronounced inhibitive action upon pathogenic bacteria, that it will inhibit or destroy the germinating power of seeds, and that it exhibits a destructive action upon the nerve cells of the small mammalia, which a sufficiently long exposure will carry to the point of necrosis and death.

Radium has been used extensively in lupus, keloid, epithelioma, carcinomata, sarcoma, chancroid, laryngeal tuberculosis, and cyclitis, and somewhat in acne, eczema, psoriasis, and pulmonary tuberculosis by causing the patient to inhale the gases from aqueous solutions of radium or thorium emanations. It is unfortunate that radium can be obtained only in such small quantities, and reports of results must, necessarily, be incomplete until larger quantities are available.

Until its idiosyncrasies are known and tabulated and a method of technic developed its use should be restricted to those who have sufficient material, proper special facilities for its application, and requisite experience in radio-therapeutic work to endow them with good judgment in selecting their cases.

Our present knowledge of it may be summed up in the statement that it is a valuable scientific toy, having feeble but pronounced therapeutic value, which has, up to now, done practically nothing that could not have been better done by the X-ray.

The next (May) issue of THE ARCHIVES OF PHYSIOLOGICAL THERAPY will be a SPECIAL ROENTGEN NUMBER, in honor of the discoverer of the X-ray and the Congress, called by his name, which will be held in Berlin, Germany, from April 30 to May 3, 1905.

CURRENT PHYSIOLOGICAL THERAPY

JOURNAL OF ADVANCED THERAPEUTICS

New York, N. Y., March, 1905.

1. Diabetes Mellitus — Francis B. Bishop.
2. X-Ray Diagnosis of Calculi — Russell H. Boggs.
3. Report of the Committee on Current Classification and Nomenclature of the American Electro-Therapeutic Association. Further Experiments with Electrostatic Machines — Samuel Sheldon. (*To be continued.*)
4. Thoughts on the Subject of Appendicitis — E. Kirkpatrick.
5. Address Given at the Opening of the American Oncologic Hospital — G. Betton Massey.

1. Bishop does not believe that any remedial measure now at our command will cure those cases of diabetes which are dependent upon organic lesions in or near the medulla, lesions of the spinal cord, or structural lesions of the liver and pancreas. He considers, however, that a good many cases are due to a disturbance of metabolism from physical or mental shock, long continued mental depression and worry, etc., and that in these cases the continuous and magnetic-induced electrical currents constitute very efficient methods of management. Dietary regulation should accompany the electricity.

His method of application is as follows:

A large surface electrode, 7 by 9 inches, is placed at the back of the head and neck; the patient reclining upon his back, with a pillow under the back of his neck; another electrode equally as large is placed over the liver and stomach, so that the upper portion of the spinal cord, the liver, pancreas, and solar plexus will be included within the field of electrical influence. The electrode at the back of the neck is made positive, that over the liver and stomach nega-

tive, and a current of 20 ma. is passed for 10 minutes. The current is then interrupted at the rate of 200 times per minute and passed for 5 minutes more.

The patient is then turned upon his face and lies upon a large surface electrode (7 by 9 in.) which is so located as to cover the region of the liver, pancreas, and solar plexus, and this electrode is connected with the positive pole of an induction coil. The negative pole is connected with an interrupting handle electrode with a surface about the size of a silver dime; the current is turned on in sufficient strength to produce good contractions, and this small negative electrode pressed down between the vertebral spines from the occiput to the last lumbar vertebra, the current being interrupted three or four times in each position.

These applications are made about three times a week.

The case of a man 60 years of age, who had been under treatment by ordinary methods for five months without much improvement, is reported. When he came under Dr. Bishop's care he was passing 1,800 c. c. of urine which contained one per cent. of sugar and a trace of albumen. The above-outlined treatment was carried out and after five seances urinalysis showed 1,600 c. c., $\frac{7}{8}$ per cent. of sugar, and a trace of albumen. After one month's treatment urinalysis showed 1,600 c. c., no sugar and no albumen. Two weeks later the patient discontinued diabetic diet and gradually returned to starchy food. Since then he has, by his own desire, been treated twice a week, but no signs of sugar or albumen have been detected. Two other cases are mentioned which are doing well, but which have been under treatment for too short a time to render reports valuable at present.

Bishop has not seen any very decided

benefit in diabetes from the use of the high-frequency currents. The sugar will sometimes diminish under their application and the patient improve generally, but he has never seen a single case cured by them.

2. See THE ARCHIVES for March, 1905.

4. Kirkpatrick recommends treating appendicitis by keeping the patient quiet in the recumbent position and refraining from the administration of morphine, cathartics, or foods of any kind; he washes out both the colon and the stomach, relieves pain by the use of heat, hops, and turpentine externally, and depends upon four ounces of normal salt solution per rectum every four hours for nourishment. For the prevention of suppuration he saturates a piece of blotting paper four inches square (with water ?) and places it on the abdomen over the seat of the pain or over the appendix. Over this is placed a copper plate of the same size, which is connected with the positive pole of a galvanic battery. A sponge covered electrode is connected with the negative pole, located upon the back opposite the positive pole, and five ma. of current passed for fifteen minutes. This is repeated twice a day, using the hematocrit for six hours to keep track of the proportion of red and white blood cells. Operation is recommended if suppuration supervenes.

He appears to believe that the action of the current carries the oxychloride of copper into the seat of the inflammation and destroys the pathogenic germs, and suggests that this method might be a good management for all diseases where there is formation of pus, as otitis, abscess of the lungs and liver, hip joint disease, carbuncles, boils, felons, etc.

5. Massey calls attention to the fact that the American Oncologic Hospital is the first institution in America to be devoted exclusively to the study and treatment of cancer and other tumors. The institution is to be devoted to

spreading a knowledge of cancer among the people whereby proper treatment will be earlier sought, to investigation of the causes of cancerous degeneration, and to investigation and development of the best means for managing cancer which is already established.

ARCHIVES OF THE ROENTGEN RAY

London, England, March, 1905.

1. Roentgen Rays and Sterility — F. Tilden Brown and Alfred T. Osgood.
2. Exophthalmic Goitre Reduced by Radium — Robert Abbe.
3. Notes of a Case of Peripheral Neuritis treated by High-frequency Currents — W. F. Somerville.
4. The Importance of Development of the Chest in the Young — E. M. Corner.
5. The Alcohol Question — Thos. Dutton.

1. Brown and Osgood call attention to the condition of azoospermia which they have found by examination to be an almost constant condition among professional X-ray workers. They have not gathered sufficient data to be able to state how much exposure or how long a time is necessary to produce this result, nor whether the result is of sudden onset or a gradual decline of testicular activity. The question of prognosis is unanswered.

One case persisted for two years after patient had discontinued X-ray work. They presume that those men who have worked behind lead screens or have employed the various tube shields will have escaped this condition. Other cases show that all those examined, whether medical men or manufacturers, demonstrators of apparatus, etc., who have been constantly in the X-ray field for the past two years are the subjects of total azoospermia. In 40 per cent. of the total cases, the interesting fact was developed that no children had been born to the wives of these men since they had taken up X-ray work. The number of

men examined so far is 16, while reports substantiating the facts have been received from others. None of the cases have been conscious of any tendency toward impotence.

2. Abbe considers the surgical treatment of goitre so dangerous from the thyroidism following the most carefully conducted removal that he hesitates to urge it upon patients. This thyroid poisoning is sudden and often fatal. Medicine affords no remedy, but he presents a case to which radium has been applied. The X-ray has been used in some cases, but with little effect.

In July, 1904, the patient, a girl of 21, who had enjoyed excellent health until the present trouble, consulted him regarding operation. Her throat was swollen in the center and on both sides, and palpitation, extreme nervousness, severe headaches, a sense of suffocation, protrusion of the eye-balls, and a pulse of 140, were present. The patient was able to walk but slowly; the circumference of the neck was $16\frac{1}{2}$ inches.

Under cocaine anæsthesia, a small incision was made in the neck and the dissection was followed to the isthmus of the thyroid. The middle lobe was $1\frac{1}{2}$ inches thick. A small incision was made in this lobe and a sterilized glass tube $\frac{1}{8}$ inch in diameter containing 10 centigrams of Curie radium (three hundred thousand radioactivity) was buried at right angles to the skin, one inch deep, and left for 24 hours. It was then removed and the wound closed with strapping. The patient returned home. There was very little change for a month, the glands seeming more swollen. This was followed by a rapid diminution and all unpleasant symptoms disappeared except huskiness of the voice.

Four months later the pulse was 105. Patient looking well, able to run up stairs, play tennis, and walk. No headache, no exophthalmos, no smothered feeling on reclining. Neck measures 15 inches, thyroid reduced to $1/6$ of its for-

mer bulk. No other treatment, except a small quantity of Carlsbad salts in the morning.

He explains the favorable action of the radium as due either to a retrograde change effected in all tissues of the gland or by irradiation of the sympathetic ganglia. He theorizes that the Beta rays of radium may not be harmful to living tissue and may apply to the nervous system that which is lacking, or to the cells of hyperplastic tissue, the inhibitory power to control over-growth.

3. Somerville reports a case of ataxia, muscular weakness, and anæsthesia treated by means of the high-frequency current. Patient a male, aged 21. Suffered from peripheral neuritis. Began first as numbness and weakness of the right leg which caused him to resign his employment as a postman. Having obtained inside employment, he improved during the summer, but in June, 1904, after a severe drenching, his left leg became affected and the disease shortly attacked the right. He was soon confined to bed and suffered loss of power and sensation in the upper extremities. He had no headache, girdle pains, or anæsthesia of the soles of the feet, nor could a specific history be obtained. The patient did not use alcohol. His gait was staggering, able to ascend and descend the stairs only with difficulty. He was scarcely able to stand with eyes shut and feet together. The reflexes were satisfactory. Sensation in the hands was impaired and his writing ataxic.

He received 48 applications of high-frequency currents. Auto-condensation was employed and the limbs electrically massaged. The ataxia had improved. He was able to ascend and descend the stairs without trouble and suffered but little fatigue. Sensation in the hands became practically normal. The handwriting improved markedly following treatment. He was able to stand perfectly straight with feet together and

eyes shut. The knee reflexes were normal.

4. Corner considers the chest to be the most important structure in the physical development of an individual. He believes too little attention is paid to the development of our bodies and that from birth care should be taken in order to enable us to preserve a healthy body. When a person who is out of condition takes exercise the heart beats rapidly. As the heart is adapted for work during rest or quiet, it must be aided during muscular exertion. This is effected by the movements of the chest. The expansion of the chest in inspiration is deeper during exercise. Not only is air inspired into the lungs, but the blood is thus aspirated from the great veins of the neck, arms, and abdomen, into the right side of the heart. The inspiration dilates the capillaries of the lungs and allows the right ventricle to relieve itself into them, and the respirations are also quickened, hence the blood loaded with the products of muscular work becomes aerated and purified when the respiration during exercise is adequate. The best index of a man's capacity for muscular work is the measurement of inspiration; it is not the external measurement of the chest, but the capability of that chest to expand and contract that is important. Thus a slight girl may be more capable of a half-mile run than a professional strong man, whose inspiration is out of proportion to his muscular development.

He calls attention to the chest, chiefly in the young and feeble, which is normally fixed in the position of expiration with the dorsal spine flexed, sternum vertical, ribs depressed, shoulders round, and hollow about the clavicles, scapulæ prominent and abdomen often projecting. Such a case suffers distress during muscular exercise. Much can be done for such a condition during the period of growth. Respiratory exercises are the remedy. Not a large chest, but a

mobile chest, is to be attained. Good chest action should be cultivated. No one portion of the body should be developed in excess of or at the expense of others. The slouchy attitude with spine flexed, head forward, and shoulders stooping must be corrected. The maintenance of a good position is an exercise in itself.

A good exercise is to stand erect with hands on hips, inspire and expire slowly, bend the body back during inspiration, and forward during expiration, allowing a pause of 10 seconds between these acts. Second, stand erect, slowly raise extended arms from the sides in a lateral direction, inspire during this, pause 10 seconds, then expire, and lower the arms slowly.

Children should be taught nasal respiration. A very large number of adenoid cases can be completely cured by these means without an operation. If the tonsils be large it is wise not to defer operation. Adenoids are frequently associated with the flat type of chest described.

Respiratory exercise should form a basis of all physical culture, particularly so in children. They are especially useful in some cases of curvature of the spine. The effect of respiratory exercise on the abdominal muscles is marked. It strengthens these muscles, keeps them healthy, and tends to minimize the risk of hernia.

5. Dutton deplures intemperate, extravagant statements indulged in by writers upon this topic and declares the matter must be investigated by medical men who can discuss the question without professional prejudice, or faddish preconception. The statement of lay writers that alcohol produces a decline in the economic value of the organism by actual change in cell-constitution is quite untrue, if the alcohol is pure and consumed in moderate quantities. He asserts that fully 80 per cent. of the profession at large partake of alcohol and

order it for their patients. If alcohol in small quantities produces the effect described the profession who are certainly not ignorant of its effects would not prescribe it. In contradiction of this he quotes the opinion of the American commission that alcohol taken in moderate quantities is purely food, while an excess of alcohol acts as does an excess of anything else. The danger lies not in the use, but the abuse of the article. It is irrational to claim that because it is abused it must be abandoned.

The appeal of the temperance platform to the chemical laboratory for argument to uphold their contention is fallacious and untrue. Bio-chemistry is very different from laboratory chemistry, and it is foolish to attempt to solve the intricate problems of bio-physiological actions by laboratory experiment. Clinical results are a much surer guide.

He advises medical men to test the value of alcohol by personal experimentation on themselves. He once for three months drank daily a regular amount of wine and spirits. This was followed in two months by gouty pains, loss of appetite, and disinclination for work. He then omitted alcohol for three months, became depressed, appetite and sleep failed; he was less inclined for work. The next three months he drank wine, beer, and spirits whenever so inclined. His appetite improved, he slept better, was ready for work, and the bowels acted regularly. He has since followed this plan, which he believes the best.

Experience has taught him that beer is the best drink for those under 40 years of age, wine after 40, and spirits should only be taken when required or ordered. He has great faith in pure beer as the beverage for growing girls and boys. He has not found that children who are allowed beer take it to excess when they attain adult life. On the contrary most drunkards in his experience have been brought up on total abstinence. He ridicules the idea that

crime is produced through alcohol. He believes that crime follows the ingestion of those drinks doctored with silent spirits, which are sold instead of the genuine article. Excess of pure drink does not cause vicious or quarrelsome actions. The spirits from potatoes, maize, etc., are responsible for the frenzy following indulgence in alcohol. He believes that wine, more especially red wine, has a germicidal action upon pathogenic micro-organisms. He would like to see a pure drink bill passed, for he believes that the physical degeneracy following alcohol is due to the adulterants used and not to pure beer, wines, and liquors.

BULLETIN OFFICIEL DE LA SOCIÉTÉ FRANÇAISE D'ÉLECTROTHÉRAPIE ET DE RADIOLOGIE

Paris, France, January, 1905.

1. The Action of the Galvanic Current upon Microbes, with Special Reference to the Nature of the Electrodes Employed — Drs. Laquerriere and Apostoli.
2. Chronic Constipation cured by Galvano-Faradization — Dr. Paul-Ch. Petit.

1. This is the record of a series of experiments made by Apostoli and Laquerriere in 1892 and 1893. They lead to the conclusion that the action of the galvanic current upon cultures of microbes is in direct proportion to the intensity of the current (in milliamperes) and in inverse ratio to the mass of liquid submitted to that action. A current of sufficient intensity kills the microbes. A current of feeble intensity, in proportion to the mass of liquid, attenuates the culture, and sometimes a weak current may exercise a reviving action upon the microbes. The microbicide effect in tubes separated by an inter-polar circuit, is exercised at the positive pole, and this action is in consequence of electrolysis which takes place there. There is no

action upon the microbes at the negative pole and in the inter-polar circuit.

As an instance may be detailed the technique of their first series of experiments. Three test tubes of equal dimensions are connected by an absorbent strand of cotton. One cubic centimeter of a culture of anthrax is placed in each test tube. Two platinum electrodes with their extremities twisted into a spiral, were dipped into the middle of each of the test-tubes at the extremity of the circuit. Ten milliamperes were allowed to pass for ten minutes. Inoculations were made from the middle of the liquid at the positive pole, and no harmful action resulted, the guinea-pigs continuing well. Similar inoculations from the center of the negative pole were made in two guinea-pigs, both of them dying in 48 hours with symptoms and lesions of anthrax.

Experiments were made with the bacillus of blue pus and comparative experiments in which the electrodes were platinum, copper, brass, silver, iron, aluminum, and carbon. The microbicide action of electrodes of platinum, copper, brass, and silver is about the same, while that of iron, zinc, and aluminum is very much less. Carbon has scarcely any. In the discussion, Oudin says that the conception of polar and inter-polar actions is entirely false. The ions are distributed in the whole circuit, and the chemical and bactericide effect take place at all points. Laquerriere responds that the discoloration of a solution of iodide of potash in the neighborhood of one pole is visible proof of a difference in the chemical property of the liquid at that point.

2. The case of chronic constipation treated by galvano-faradization, was that of a man 33 years old, who had been treated since 1892 for dyspepsia and gastritis. The moment he sat down at the table the blood mounted to his head while his feet became like ice. He had colic which continued until after an

abundant evacuation. He was not able to eat with a good appetite. As to the movements of the bowels, they did not occur except after glycerine injections. The stools were hard and formed of a conglomeration of very dark balls. He had been treated in 1904 by fifteen applications of static sparks in the region of the colon without any appreciable results. The abdomen was soft although somewhat thin, and no hardened matter could be felt in the intestine by palpation. A large electrode was applied over the region of the loins, another of the same dimension over the abdomen. A galvanic current of 60 milliamperes was combined with a feeble faradic current which the patient perceived as muscular vibration of the abdominal wall. The following day there were two natural somewhat soft movements. Applications were made every two or three days from the 8th of October to the 26th of November, and these twenty seances sufficed to cure a constipation of several years standing.

The patients never feel any colic during the seance, there are no evacuations for a good many hours afterward, usually not until the next day and sometimes not until the second day. It seems as if the first result has been to lead to movements, and that the second part of the treatment has been to regulate them so that there has been one every day. The Faradic coil used was one with coarse wire.

In discussing the paper, Laquerriere called attention to the fact that most cases of constipation are spasmodic and the value of galvano-faradization was very great.

BULLETIN OFFICIEL DE LA SOCIÉTÉ FRANÇAISE D'ÉLECTROTHÉRAPIE ET DE RADIOLOGIE

Paris, France, February, 1905.

1. Recurrent Epithelioma of the Lower Lip treated by the X-ray — Dr. Vidon.

2. Obstinate Cough relieved in Consequence of Applications of the X-ray — Drs. Dubois, Chavry, and Kocher.
3. Three Cases of Metrorrhagia, treated by High-Frequency Currents — Dr. Fauchon.

1. Man of 62 years of age who had been cured of an epithelioma of the lip in 1902 by the application of caustics. The original cause had been a very painful burn from a cigar. At present the cicatrix of the original trouble is at a little distance from the right labial commissure. There were little nodules which seemed like epithelial pearls, but which had not shown any increase since May, 1903. The recurrence dates from the middle of July, 1904. It appeared at the middle of the lower lip, entirely outside of the cicatrix of the former trouble.

Treatment was begun in October, at which time the lesion was about 11 millimeters in diameter, and was covered with a brown crust. There were no enlarged glands. From the 14th of October to the 14th of January thirteen applications of the X-ray were made at intervals of about a week. Treatment was with a small osmo-regulator tube, the anti-cathode being red hot most of the time. The patient's lip was at a distance of 5 centimeters from the wall of the tube, a sheet of lead being used to protect the parts that were not being treated. The irradiation was at the rate of $\frac{1}{2}$ Holzknecht a minute, and the quality of the ray was No. 6 Benoist. At the first six seances three Holzknecht units were applied each time. The result was an increase in the flexibility of the lip and also in the amount of secretion which became more fluid. At each of the following six seances 4 Holzknecht units were applied. The secretion then became less, the crust took on a horny aspect, the patient cutting it off several times with the scissors. This crust fell off entirely after the twelfth seance, and was replaced by a gray

parchment-like membrane much larger than the original epithelioma. On removing this the lip was found entirely cicatrized except a point about as large as the head of a pin. On the 14th of February, 1905, there remains in the place occupied by the epithelioma no trace of any lesion whatever. The total time of exposure amounted to 46 Holzknecht units. The only sign of reaction observed was a slight oedema of the lower lip, which appeared two or three times following the stronger applications.

2. One of the cases in which an obstinate cough was relieved by X-ray applications was that of a patient with a primary inoperable cancer of the larynx; another, being a patient with sub-clavicular bilateral metastases following an operation for cancer of the breast. Both patients had been treated with heavy doses of the X-ray of 4 Holzknecht units. The cough diminished in a very remarkable way after each seance. He thinks that the benefit was partly due to the direct action of the X-ray on the pneumogastric nerves, and partly following the progressive benefit upon the neoplasms. In one of these cases a fluoroscopic examination showed unequivocal signs of a peri-bronchial glandular involvement, which was important because of a tendency to attribute such involvement to the X-ray. It was present in this case before the X-ray was used.

3. Fauchon says that high-frequency currents act in cases of metrorrhagia with as great if not greater rapidity than the galvanic current. They have the advantage of requiring only fifteen-minute seances, while 25 to 40 minutes are required for the galvanic. Furthermore, no large abdominal electrode is necessary. An ordinary intra-uterine copper electrode was used, the vaginal portion being covered with a rubber tube.

One case was that of a lady aged 20 years, with a small fibroma in the ante-

rior wall of the uterus. A d'Arsonval apparatus was used in connection with a six-plate Gaiffe's static machine. The current was as powerful as possible. The duration of the application was ten minutes and there was no pain during the application. Two or three treatments were given, the metrorrhagia was entirely stopped.

Another patient of 45 years of age with a fibro-cystic tumor of the uterus which had been treated in 1903 by galvanopuncture of the tumor. In April, 1904, she was suffering from an abundant metrorrhagia. She was very anæmic. No trace of the previous tumor remained, but the uterus and cervix were large and congested.

The first application was of 15 minutes duration, and the hemorrhage stopped almost completely the following day. The patient was seen again three months later and after this single application there had been no return of the trouble. The periods were regular and not excessive.

Another patient 50 years old, the periods returned every 15 days—in fact she was always flowing. A single application of high-frequency currents for ten minutes was made. The loss of blood continued for several days afterward, then ceased completely and has not returned. The current in this case was supplied by a 35 centimeter coil, with a vibrating interrupter, and 6 amperes of primary current.

In the discussion Dr. Desnoyers said that in treating cases of sciatica it was necessary to employ as much as 600 milliamperes for 10 minutes, and that the high-frequency currents and the coil are so much stronger than those of the static machine that the time required was only about one-third as long.

ARCHIVES D'ELECTRICITE MEDICALE

Bordeaux, France, February 10, 1905.

1. Electric Treatment for various Œsophageal Strictures—Dr. C. Roques.
2. Two Cases of Grave Neurasthenia Treated and Cured by Static Electricity—Dr. E. Bonnefoy.
3. What I have Seen in Germany in Medical Electricity—Dr. Virgilio Machado.
4. Experiments on the Relation of the Current in the Crookes' Tubes by Dr. Villard's Method—G. Gaiffe.

1. One patient was 45 years of age, a seamstress. At the age of 20 years she had begun to have a sensation of a lump in her throat, strangling dyspnoea, and vomiting. The commencement of this was coincident with a period of overwork, especially with the sewing machine. About three years before she had been very unhappy about different matters, and in the month of May, 1902, a very painful dysphagia was added to the other troubles, so that it was absolutely impossible for her to swallow, and she vomited immediately any food which she tried to take. No food except small quantities of milk had been retained, and finally the vomiting occurred even without taking food.

She came under treatment on the 28th of January, 1903, and on trying to pass an Œsophageal tube it was found that No. 6 passed readily enough, and then larger sizes. Electric bougies were passed by means of the galvanic current up to No. 21. One could perceive, however, that there was a spasm of the Œsophagus, which appeared particularly in the region of the cardiac orifice of the stomach. After this treatment she swallowed bouillon, some soft bread and soup. Milk was rejected but the bread was retained. At a second seance the galvanic bougies were passed up to No. 36. From this time, with occasional treatment, there was rapid and progressive improvement, all treatment being

stopped at one month from the day of commencement. Six months later the patient was seen, and was well nourished, but still had a little difficulty in swallowing, and sometimes vomited. Six months after that there were six more treatments, about one every two days, the Faradic current being used for a couple of minutes, and also a static current—both being given. This checked the vomiting and dysphagia entirely, and three months later she was entirely free from the former troubles.

Another case was that of a woman 55 years of age, who had had gastritis two years before, cured in a couple of months. Recently she had taken a mouthful of a solution of potash, thinking it to be wine. She was sure that she had not swallowed any of it, but from that time she was not able to swallow any large morsel of food, and any swallowing was painful and difficult. The dysphagia was progressively worse, and finally vomiting appeared. The food was immediately rejected, and the vomiting a few hours later was followed by abundant glairy mucus. She became thin and weak. Simple catheterization was attempted but without success.

An examination by means of an œsophagoscope was made, which showed an œsophageal stricture about 22 centimeters from the dental arch, presenting a small orifice a little behind and to the left of the mass of cicatricial tissue, which admitted a small pledget of cotton about 3 millimeters in diameter.

Treatment was by electrolysis and from the moment it was begun there was dilatation of the stricture and relief of the patient. This took place so rapidly and so steadily that the case is very interesting. The dilatation was practiced by means of bougies having a bulbous extremity, and a current of 10 milliamperes for several seconds for each bougie, the numbers used during the first seance being 19, 20, 21, 23, 25. Treatment was given every other day, and at

the end of the first week a No. 33 bougie could be passed and the patient was able to eat like any one else. On this particular day there had been a spasm of short duration which had prevented her from swallowing even a little coffee, but a moment later she was able to eat a good meal.

After three weeks of treatment another œsophageal examination was made which showed that the stricture was very much wider and more dilatable, and that the mucous membrane had become natural instead of appearing like cicatricial tissue as before. Treatment was stopped at this time, and the patient was seen two months later, still being very well; but about three weeks previously the dysphagia had suddenly reappeared and since then solids and liquids were swallowed with great difficulty and rejected either immediately or perhaps 10 minutes later. This seemed to be due entirely to a spasmodic condition, and the same treatment was begun again, with the addition of a weak faradic current for about 10 seconds. Three days later the patient was considered entirely cured.

In cases of stricture of the œsophagus there are sometimes two elements—one an organic stricture and the other a spasmodic condition. The organic trouble requires the galvanic current which actually produces a physical effect upon the tissues, whereas the faradic current simply relaxes the spasms, and is suitable as a local application, even when the spasm of the œsophagus occurs from other sources of irritation.

2. Bonnefoy thinks that static electricity is really the thing for neurasthenia and that its action is of a triple nature: (1) upon the circulation, by increasing the rapidity of the heart action, raising the arterial tension, and giving an impulse to the capillary circulation; (2) upon the action of the respiratory capacity of the blood, by increasing the quantity of oxygen which the red corpuscles carry; (3) an action upon diges-

tion and assimilation, increasing the appetite and accelerating the digestive functions, and in this way producing a rapid increase of weight. The treatment ought to be of moderate strength and duration at first, because otherwise the increased arterial tension may act to increase the insomnia if the patient is not accustomed to it.

One case was a man 40 years of age suffering with insomnia and very great muscular debility, intense headaches, a suicidal tendency, and entirely unable to attend to his business. He also had hæmorrhoids. The first seance was of 10 minutes duration, in the middle of December, 1902, and the arterial tension was immediately increased more than 2 centimeters, with the result that the patient was not able to close his eyes all night. A six-plate static machine was used. At the next treatment only half the strength of the static machine was used, and the patient was able to sleep 6 hours during the night, in three different periods. By the 20th of January the full strength of the static machine was used and he slept every night for five or six consecutive hours. His appetite and digestion became good, the headaches disappeared, and he was able to work a little without causing the cerebral fatigue which the least intellectual effort had previously caused. This patient presented all the symptoms described by Charcot as characteristic of Beard's disease—intense "en casque" headaches, insomnia, the characteristic cerebral condition, muscular weakness, and gastro-intestinal dyspepsia.

Another patient was a lady 30 years of age, with a very nervous temperament who had suffered from regular hysterical crises with loss of consciousness, following scarlet fever four years before. These had become so severe that she was able to take scarcely any food and was confined to bed. Her arterial tension at the wrist was 8 centimeters at the beginning of the treatment. At the end of a

week her condition was improved as if by enchantment. She passed comfortable nights and her sleep was quiet and without nightmare. Her appetite returned, arterial tension rose to 11 centimeters. At this time a few static sparks were added over the dorso-lumbar region and lower limbs. At the end of two months' treatment she was able to walk six or eight miles in the open air, and her arterial tension was 15 centimeters. Several months later she was still feeling very well and the arterial tension was 15 centimeters, no treatment having been given in the meanwhile.

3. Hydro-electric applications are very generally used in Germany. The patients dip all four limbs into little baths to which a galvanic or faradic current is applied, or the two combined. Electro-cataphoresis is used for the introduction of various drugs into the organism. High-frequency currents are much used for treatment of diseases of the skin and of tuberculosis. Conrad's electro-magnetic system is very largely used, especially in the treatment of neuralgia, neurasthenia, and insomnia. Electric light treatment is used more than in any other country of Europe. Finsen light is used. In Munich they have a smaller lamp which works with 40 amperes and is very much less expensive, and produces as good results as the Finsen apparatus. Red light baths are used as a stimulant in the treatment of anæmia and neurasthenia, and blue light baths as a sedative in neuralgia and certain dematoses. All sorts of electric motors are used to produce vibration, etc.

The two interrupters which are most employed are the mercury jet interrupter and the Wehnelt. Simon's electrolytic interrupter is not so generally employed, and Heinze's interrupter does not seem to be used at all. Very common use is made of the ventril tubes to suppress the inverse current in X-ray tubes actuated by a coil. No use is made at all of the

static machine for the production of the X-ray, and almost all the tubes are of the bi-anode focus type. Those most commonly used being made by Müller of Hamburg. Other very fine tubes are made by the Polyphos Company, formerly the Volt-Ohm of Munich, and the Sanitas Mfg. Company, also Gundelach of Gehlberg.

Among diseases treated by the X-ray are lupus, epithelioma, rodent ulcer, favus, sycosis, trichophytia, hypertrichosis, warts, eczema, acne, sarcomata, glandular enlargements. They are just beginning to use shields of lead to protect the operator and the patient. They use Walter's chromo-radiometer, the Benoit radio-chromometer, and the Holzknecht chromo-radiometer to measure the quality and quantity of the ray used. Among the important data which are considered in determining the rays from the Crookes' tubes they take into account the following—the coil used, the voltage, and amperage in the primary, the number of interruptions per minute, the quality of the tube, the spark length, and the distance of the anti-cathode from the region to be treated, the penetration, as indicated by the chromo-radiometer of Walter or Benoit, the action upon the Holzknecht—or, if one has not the Holzknecht—the time of the exposure and the interval separating the seances. They do not appear to have begun to use the milliamperemeter placed in series to measure the secondary current passing through the X-ray tube.

4. Gaiffe calls attention again to the use of two ventril tubes connected on a short circuit allowing the inverse current to pass through them, and shows a very pretty experiment with an electro-magnet and a Geisler tube. In the one case without the two ventril tubes the light in the Geisler tube is separated into two halves—one projecting toward the north pole of the magnet and the other toward the south pole; in the other case, using the two ventril tubes, the light

deviates toward only one pole of the magnet, showing that one set of vibrations has been suppressed by short-circuiting through the ventril tubes.

ARCHIVES D'ELECTRICITE MEDICALE

Bordeaux, France, February 25, 1905.

1. Concerning the Indications furnished by Benoit's Radiochromometer — Dr. J. Belot.
2. The Use of Compression in Radiography and a new Compression Diaphragm — Dr. J. Bergonie.
3. The Practice of Radiography and Radiotherapy in Germany — Dr. Jaime R. Costa.

1. Benoit's radiochromometer consists of a thin disk of silver surrounded by sections of aluminum varying in thickness from one to ten millimeters. This can be used either with the fluoroscope or in a radiograph for determining the quality of the X-ray. The silver appears of the same shade as that one of the aluminum segments which presents an equal resistance to the X-ray. The thickness of the aluminum segment in millimeters designates the degree of penetration of the X-ray emitted by the tube at the time the test is made. An important advantage of this instrument over Walter's radiometer is in the fact that Benoit's instrument gives readings which are independent of the intensity of the radiation and depend only on the quality of the ray. Another fact is that this instrument measures the average degree of penetration, not the maximum penetration, at the time the test is made. We have no means of determining the different qualities emitted by an X-ray tube at any one time. The X-ray is not refracted or reflected, so no spectrum analysis of it can be made. It is probable, however, that if the radiochromometer indicates No. 7, there are some rays No. 8 and some No. 6, but practically no Nos. 1 or 2.

2. Begonie believes in the necessity for excluding secondary rays by a cylinder and diaphragms and hence does not consider compression alone, as by Caldwell's inflated rubber bag, sufficient.

At the same time he considers Albers-Schoenberg's compression cylinder needlessly complicated and expensive. His own consists of two uprights with a cross piece which may be secured at any height by thumb screws. At the lower extremity of the cylinder there is a large hollow cushion which enables one to make more effective pressure and without the discomfort produced by the hard lower edge of a metal cylinder.

3. Costa gives a résumé of the apparatus and technique of the various well-known radiologists in Austria and Germany. Holz knecht, Albers-Schoenberg, Rieder, Grunmack, and Perthes are among those whose work is minutely reviewed. Albers-Schoenberg's success in radiography depends upon (1), fixation of the part radiographed; (2), electrolytic interrupter and variable self-induction in the primary coil, and an average primary current of fifteen amperes; (3), the use of soft tubes giving rich detail. He uses large Müller tubes of the water-cooling type. Rieder takes excellent pictures of the chest in five or ten seconds, using a powerful Volt-Ohm apparatus, celluloid films and two intensifying screens.

1. Certain cases of gastralgia and the like are part of a neuropathic condition caused by auto-intoxication and ennu. Priessnitz compresses are cold, wet applications covered with oiled silk and left on the abdomen all night. The bodily heat soon changes the application to a warm one. The local effect is to stimulate both circulation and nerve force and the general effect is most beneficial.

2. Abdominal massage acts partly in a direct mechanical and partly in a reflex manner. Directly it stimulates the blood current, causes the absorption of œdema, and the emptying of the large intra-abdominal cavities and the excretory ducts of the different glands. By a reflex action one can produce either vasodilation or vaso-constriction and in this way regulate the arterial tension. Metabolism is greatly stimulated and a remarkable tonic effect is produced. It may be applied in such a way as to produce an important sedative effect upon the general nervous system. The hands are the best instruments, but where powerful vibratory massage is required one of the mechanical vibrators must be used. General massage of the abdomen is indicated as a tonic in convalescence from acute diseases and in anæmia and chlorosis. It is important for an effect upon arterial tension and to modify general nutrition in arthritism, obesity, diabetes, gout, chronic rheumatism. In certain diseases of the heart, in arteriosclerosis, and in blood stasis and active congestion of the respiratory organs its effect upon arterial tension is of value.

Local massage is indicated in a variety of chronic affections of the stomach, intestines, liver, pancreas, spleen, kidney, bladder, prostate, uterus, and adnexa.

Contraindications are acute or subacute diseases, cancer, local tuberculosis, acute hæmorrhages, acute or subacute local infection, pregnancy.

3. Helium is the radioactive element especially found in these thermal waters.

JOURNAL DE PHYSIOTHERAPIE

Paris, France, February 15, 1905.

1. A Variety of Algia; its Pathogeny and its Treatment by Priessnitz Compresses — Dr. Prosper Merklen.
2. The Importance of Abdominal Massage and its Role in Therapeutics — Dr. Salignat.
3. The Chemical Composition of the Radioactive Gases from various Thermal Springs — M. Ch. Moureu.
4. Chair and Couch for Electro-Therapy — Dr. E. Albert-Weil.

It is a derivative of radium, which is itself present in minute quantities in the gas from these springs.

4. This wooden arm chair has a back which may be converted into a table. The construction is simplicity itself, but it is suitable for the sitting or lying position for all sorts of radio- and electrotherapeutic applications. In the sitting position there is a head-rest which may be tipped back for applications under the chin.

FORTSCHRITTE AUF DEM GEBIETE DER ROENTGENSTRAHLEN

Berlin, Germany, Vol. viii, No. 3.

1. Contribution to the Topography of the Gastro-Intestinal Canal in the Living Man, together with Investigations concerning the Duration of the Process of Digestion — Prof. H. Rieder.
2. The Trochoscope, a Universally Adjustable Table for Radiography — Dr. G. Holtzknecht and Dr. I. Robinsohn.
3. For the Simplification of Screen-Technique. The Angular Screens — Dr. I. Robinsohn.
4. The Deep Distribution of X-ray Effect — G. Holtzknecht, Vienna.
5. Application of the X-rays for the Diagnosis of Bladder Deformities — Dr. P. Wulff, Hamburg.
6. The Alternating Current and its Applicability in Roentgen-Work — Dr. B. Walter.
7. Contribution to the Radiotherapy of Blood Diseases — Dr. Paul Krause, Breslau.

1. In these investigations Rieder makes use of bismuth mixed with the food, using about an ounce mixed with about a pint of liquid, either milk or broths. He finds no danger or inconvenience resulting from the use of this large quantity of bismuth except obstipation. He calls attention to the dangers and inaccuracy of the older methods of examination by means of the sound and gas.

The patient is examined either in the standing or the sitting posture. The an-

ode of the tube is placed on a level with the umbilicus and at a distance of 60 cm. from the plate. The location of the umbilicus is marked by fastening to it a coin. The exposures are made in a few seconds while the patient holds his breath. Fresh developer is used for each negative.

The position of the stomach is influenced by the amount of contents, by its peristaltic movements, and by certain individualities and habits. In general the normal position is vertical and this is especially true in women.

The article is accompanied with a number of beautiful plates which show the position, shape, and size of the stomach both in health and disease. The author has also made studies to determine the time required for food to pass from the stomach and through the bowel. The time occupied by the food in passing through the stomach is not influenced by the presence of the bismuth.

The passage of the food through the bowel is considerably retarded by the presence of the bismuth. Normally from 3 to 6 hours are required to pass the stomach, and from 48 to 60 hours to pass the bowel. No difference is noted in the time required for either proteids or carbo-hydrates to leave the stomach, but fats are slower. Water is found to leave the stomach in from $\frac{1}{2}$ to $\frac{3}{4}$ hour, while beer leaves more slowly.

The size and position of the colon can be studied either by the ingestion of food containing bismuth or by the administration of enemata containing bismuth, and the author has found that the position is the same when studied by either method.

The article is also accompanied by a detailed report of the cases studied.

2. This apparatus enables the examiner to study the patient in the recumbent position, and to reduce fractures and search for foreign bodies under the immediate direction of the fluorescent screen. The table contains a rotating

disk underneath, which carries the tube, and this is in turn mounted upon a carriage which is worked with pulleys which enable the operator to bring the tube into the proper position for study of the part under examination, without moving the patient. The compression screen is also an attachment.

3. The author simplifies the technique of using screens for the elimination of rays from the parts not actually under examination, by using two sheets of lead, the inner borders of which are cut into a right angle. These two sheets are then approximated until the proper size opening is left for the part under examination. The author believes that the photographs are improved by this method.

4. Holzknacht is of the opinion that the X-ray effect depends upon the degree of absorbability of the tissue through which it passes, and also that the effect will vary with the quality of ray used. Each layer absorbs a definite quantity, and the next layer will absorb another definite proportion, but there is always a certain small proportion which passes on to the next.

5. Wulff demonstrated a deformity of the bladder by injecting a solution of bismuth as follows: Bi, subnit 5.0, Amyl. 2.0, Aq. ad. 50.0. The skiagraph then showed the size and position of the bladder. He speaks of the method of Keller in which the bladder is distended with gas, but Wulff believes his method to be more practical and more precise.

6. Walter here gives the second, or practical part of his paper upon the use of the alternating current in Roentgen work. The application of these currents is made by means of a motor interrupter, an electrolytic interrupter, a synchronous motor placed in circuit with the tube, or by means of a special tube containing two cathodes, so arranged that they focus

upon the same point upon the anticathode. The two wires from the secondary coil are then attached to the cathodes. With each alternation of the current one cathode becomes anode and the other the true cathode. A constant stream of rays are obtained in this way. The objection to this method is the expense and difficulty of making the tubes, and the fact that the tube must always be kept at low vacuum.

7. Krause gives a very complete review of the work done so far in the treatment of blood disease with the X-rays. Most of it has been done in leukemia. He has collected forty cases of this disease that have been treated by the X-ray. The improvement is easily divided into two headings, subjective and objective. In myelogenous leukemia the subjective symptoms seem to be completely relieved, while in the lymphatic variety the symptoms as a whole are apparently not relieved and indeed seem to be made worse.

The objective symptoms are improved as respects the condition of the blood, the size of the splenic tumor, and the increase in weight of the patient. The improvement in these respects in some cases was remarkable.

The author has collected also 10 cases of pseudo-leukemia. In general there was improvement, but in many cases this improvement was not permanent. He also has collected other cases of blood diseases that were treated, splenic anæmia, Banti's disease, malignant lymphomata, pernicious anæmia.

On account of the increase in hæmoglobin and in the number of red corpuscles dependent upon its use, the author applied the X-ray in two cases of pernicious anæmia and in one case noticed improvement. He believes that more observations should be made in this line.

ELECTROTHERAPY

SOME OBSERVATIONS ON THE EFFECT OF ALTERNATING CURRENTS OF MODERATE FREQUENCY ON DOGS

G. W. Crile and J. J. R. Macleod, *American Journal Medical Sciences*, March, 1905.

The experiments were carried out by means of the alternating currents used for illuminating purposes, varying in tension from 400 to 2,700 volts; frequency 60 periods per second. The electrodes were made of copper or zinc, shaped either as thick rods which could be placed in the rectum or mouth, or spoon-shaped for application to the surfaces of the body; these were usually wrapped about with a sponge soaked in saline solution to increase conductivity. Dogs rendered anæsthetic by morphine and A. C. E. mixture were used.

It was found that the lethal current strength varied within limits of considerable latitude, that the lethal tendency was governed largely by the location of the electrodes, and that when the current was passed directly through the heart fibrillary contraction of the ventricles, the auricles continuing to beat normally, was induced which resulted in permanently lowering the blood pressure. Whenever the current was applied so as to traverse the heart and produce fibrillary contraction respiration was also permanently inhibited. If the current was not applied so as to traverse the heart substance, a temporary cardiac and respiratory inhibition (through stimulation of the vagus nerve probably) was induced, but these functions re-established themselves when the current was broken. With the electrodes in the mouth and rectum the current would necessarily pass through the heart and the results were always lethal when they were so located; when so located that the heart was not directly traversed, as

on the two anterior limbs for instance, the animals were not killed.

They conclude that death under electrification is due to a direct effect of the current upon the heart muscle causing fibrillary contraction, and that if the current traverses the body so as to avoid the heart, temporary vagal inhibition of the heart and respiratory centers may occur but not death; these functions will be re-established when the current is broken.

As a possible prophylactic measure for persons exposed to the action of strong currents it is suggested that they wear a corset made of some conducting material, as copper. To be of value this corset would have to be closely applied to the skin about the shoulders and base of the neck above, and to the lower portion of the trunk below; in the cardiac region it should be separated from the skin by a layer of some non-conducting material, as India rubber. Contact with the bare skin at the upper and lower extremities of the corset is necessary in order that the current passing along the body might have every facility for choosing the route of less resistance through the corset, rather than through the body tissues underneath it. By this means the heart might be protected from the current and lethal results avoided. Wearing such a corset over a woollen garment, whereby contact with both ends of the corset and the skin would be prevented, would therefore destroy the effectiveness of the protection; the woollen acting as an insulator.

THE PRINCIPLES OF ELECTROTHERAPEUTICS

A. D. Rockwell, *The Medical Brief*, February, 1905.

"Electro-Therapeutics," the author claims, "cannot be considered a specialty

in the sense for example that neurology or ophthalmology are specialties." It is simply the application of a single remedy, although one having an enormously wide range, double-edged, many sided. Because of the power of electricity to modify the nameless and numberless phenomena that energize living tissue, and its influence over nutrition, it belongs to every specialist as well as to every general practitioner.

Unfortunately, however, for its general, successful utilization a far more intimate acquaintance with its physics and physiology, and with the laws which govern the action of its various manifestations on living tissue, is demanded of the average practitioner than he can claim to possess. How many physicians who undertake to utilize electricity understand Ohm's law? But yet this law is the foundation upon which is built the whole superstructure.

According to Rockwell the two principles upon which we must mainly rely in the use of electricity for diseased conditions are:

1st. Its influence over vaso-motor activity, and 2d, its action on the nerve units of the body.

Pain must be due, as a rule, if not invariably, to pressure upon nerve cells. If structural changes or organic conditions cause the pain, it is well understood that it is either incurable, or will yield only to operative procedure. If it be due to blood pressure, as is evidently the case in the majority of instances, the relief of pain is coincident with the relief of pressure. Electricity is quite capable of exciting the activity of the circulation through congested areas. It induces a sort of circulatory drainage, acting very much on the principle of heat, the difference being that its effects are more far-reaching, as evidenced for example, by the influence of massive doses of electricity over the pain of deep-seated malignant growths.

The second underlying principle, viz.,

the action of electricity on the nerve units, or neuron bodies, while more conjectural as to its nature than the vaso-motor effects, seems yet to be a necessary theory to account for the very remarkable effects so often obtained through the use of this agent in the various neuroses, in such conditions as neurasthenia, hysteria, and hysterical paralysis, and those cases of mental disturbance that have not yet crossed the border line separating them from actual insanity. The neuron concept has not yet developed into an established fact. Indeed much doubt has been thrown by later histological studies, by the work of Apath and Nissl especially, on this theory of the transmission of nerve impulses, but whether these nerve impulses are transmitted from the center towards the periphery through a permanently continuous chain of nerve tissue, or through individual nerve entities that are in contact by contiguity, the fact remains that the nerve wave is frequently interrupted in its course.

Sometimes this interruption is permanent, sometimes only temporary. If permanent, the causes are organic or structural, and we get some form of incurable paralysis or insanity. If temporary, we have to deal with what in our ignorance we term a "functional" causation, and the paralysis or amnesia, or mental disturbance either recovers spontaneously, or is amenable to treatment.

If we accept the theory of amœbic movements (by which is meant the power of the neuron under pressure to expand and contract by means of the protoplasmic prolongations) by which the connections between neuron and neuron are alternately made and broken, we not only have a convenient, rational theory in explanation of the functional neuroses, but an explanation as well of the curative effects of purely neuro-motor excitations and of physical methods of treatment.

There is no form of electricity but

what has a certain influence in this direction, yet for the purpose of increasing general nutritional activity, exciting metabolic changes, and developing the potential energy of the cell life, it seems to be the general consensus of opinion that we have in these currents of high frequency and high potential, an energizing principle superior to the other electric modalities. On the neuron the influence of all high frequency currents, and of what is termed vibratory therapeutics, must be in the main mechanical or electro-tonic. Changes are produced in the excitability of the neuron. New connections develop from out the protoplasmic prolongations, opening up new paths of conduction for the transmission of the nerve-waves, the obstruction of which gives rise to so many symptoms of disease. The powerful influence of strong emotional excitation in dissipating certain functional nervous symptoms has long been recognized.

It is believed that these purely emotional neuro-motor excitations accomplish these results by overcoming the non-conductibility of the resistant neuron. In the same way it seems rational to believe that when a patient is placed within the field of influence of currents of high frequency, or is subject to such influences as central galvanization, general faradization, the static wave current, or high-frequency currents, the resultant effects over sensory, motor, and mental symptoms are due to the power of these electric impulses to so stimulate the cell energy as to open up new paths for the transmission of the nervous current.

ENELECTROLYSIS: AN IMPROVED METHOD OF OPERATING ON SUPERFLUOUS HAIRS

Balmanno Squire, *London Lancet*, February 25, 1905.

The electrolytic destruction of hair as hitherto practiced has involved passing

a sharp needle into the follicle, alongside of the hair, until the root or papilla has been reached (the hair being taken as a guide to the direction which the needle should follow), and the current then passed for a period of time presumably long enough to destroy the papilla, when gentle traction upon the hair with a pair of tweezers will easily remove it if the current has done its work. Prominent among the objections to this method are the following:

First, the direction (slant) of the hair outside of the skin is not a trustworthy indication of its direction in the substance of the integument (hairs frequently curl abruptly as soon as they emerge), hence finding the root of the hair with the needle point sometimes involves several applications of the current to different locations before the papilla is finally located; as a consequence several foci of electrolytic destruction are formed which sometimes results in disfigurement that is worse than the presence of the hair.

Second, the necessity of passing the needle down *alongside* of the hair renders it necessary to destroy a large area of tissue, in order that the destructive influences may be radiated to a sufficient distance to include all of the papilla.

Squire proposes to *pull out the hair first* and then pass the *blunt (eye) end of the needle* into the follicle where it occupies the space previously occupied by the hair itself, and enables the operator always to apply the current exactly at the spot which it is desired to treat, without destroying unnecessarily large areas of surrounding tissue. This method is much quicker than the old method because only a very short electrolytic action is required to destroy the papilla when the needle is in actual contact with it, disfiguring was reduced to a minimum, the pain produced is practically *nil*, and as the needle is merely entering a passage already existent it is

thereby guided in the proper direction for reaching the papilla, obviating the necessity of the operator's guessing at the direction and being deceived. Using the blunt end of the needle causes it to pass in easily, whereas if the sharp point was used it would be likely to stick into the sides of the canal, carrying the destructive action into neighboring tissues.

A little caution is necessary as regards locating the orifice after the hair has been removed. To make this certain it is recommended that the operator keep his gaze fixed constantly upon the orifice, after the hair has been pulled out, until the needle has been inserted; after this has been accomplished a little pressure in different directions will cause it to slip easily into the follicle. Location of the orifice can also sometimes be facilitated by observing its bearings with relation to neighboring hairs, before removal of its contents.

Squire suggests the name of "Enelectrolysis" for this procedure.

CLINICAL RESULTS OF HIGH-FREQUENCY CURRENTS

A. W. Crane, *Fort Wayne Medical Journal-Magazine*, March, 1905.

Although the public has always had a considerable amount of vague faith in the curative power of electricity yet it was not until the discovery of the diagnostic and therapeutic powers of the X-ray that the members of the medical profession were inclined to give it any great degree of credence. Crane makes the statement that the method of so transforming the discharge from a large coil, which is too powerful to be applied to the human body, so that it could be utilized, was discovered in America several years before the X-ray was known, but that the therapeutic possibilities involved lay dormant until d'Arsonval and Oudin developed them.

Crane manufactured his own resonator as follows:

"A bobbin of wood, thirty inches long and having a diameter of ten inches. Two sizes of copper wire are used, the larger size being known as No. 8, the smaller size as No. 16. The larger size wire (No. 8) is wound around the bobbin 24 times, with four turns to one inch of the length of the bobbin. The smaller size wire (No. 16) is wound around the bobbin 192 times, with eight turns to the inch. The windings of the larger wire are separated from one another by windings of cord one-eighth of an inch in diameter. The smaller wire is wound on ribbed rubber matting such as is commonly used on stairs and in hallways, the wire being wound in the grooves of the matting which are just right for the purpose. The condensers are made by pasting tin foil on window glass. There should be from 100 to 200 square inches on each surface, with margins of two inches.

"The full size resonator—thirty inches long and ten inches in diameter—when completed gave me a very abundant effluvia of soft sparks eight or nine inches long, which felt on the hand like the touch of a feather duster. If the hand were close enough, however, a vivid, crashing spark of six or seven inches would jump from the machine. But if a piece of metal be held between the fingers to receive the impact of the spark, nothing can be felt. The discharge is given off from a single terminal. There are no positive or negative poles in the same sense as with the galvanic, faradic, and static machines. And if this single terminal be seized, the entire discharge of our resonator can be taken without the slightest sensation or muscular contraction of any sort."

He believes the current derived therefrom is not an oscillating one, but unidirectional, and bases his belief apparently, upon observation of the method in which the X-ray tube lights up when it

is hung from a single pole of the resonator by its cathode terminal. The following cases which were treated with the above-described apparatus are reported:

"Case 1. — One of my first cases was that of a business man whose office is in the same block as my own. He had arisen from bed that morning with a very stiff back, but managed to get down town. During the morning, however, the trouble increased very rapidly so that he could not assume any position that was not acutely painful. When he was helped into my office the diagnosis of acute lumbago was clear. I applied the high-frequency current through the medium of a vacuum tube for fifteen minutes to the bare skin of the back. At the conclusion of the treatment the patient asserted emphatically that he was entirely well. He had no pain whatever. He could take any position he wished. He refused to go home, and took no medicine. He returned at once to work, and there was no recurrence after that single treatment. I have verified these results with many acute lumbagos since; except that often the symptoms return after thirty-six hours, and the patient will come in for several more treatments.

"Case 2. — A somewhat similar case was that of a young man who came in with his head drawn stiffly to one side by an acute torticollis. The effect of the treatment was immediate and the patient left the office wholly relieved. There was no recurrence and no second application.

"Case 3. — Another case was that of a chronic rheumatism of the knee which had caused the patient to limp for a year, and had entailed much suffering. It will illustrate the extraordinary anæsthetic powers of the current. The first treatment of fifteen minutes wholly relieved the pain, and the patient walked off without a limp. But after about thirty-six hours all symptoms returned. Applications were repeated every other day un-

til finally after fifteen treatments the knee remained well.

"Case 4. — Gout is a fine subject for high-frequency treatment. Pain is at once relieved, and the swelling and redness disappear after a few treatments.

"Case 5. — The high-frequency current is of marked service in many rectal disorders. In one case, a chronic fissure in ano with ulceration healed with surprising rapidity. Pruritis ani is largely controllable by this means. Hemorrhoids which can be replaced seem to be curable.

"Case 6. — The most remarkable case I have to report is that of a woman of 66 who for four days previous to her visit at the office had been in constant pain in the rectum and throughout the pelvis. For months preceding she had had more or less pain daily, especially on defecation. Her passages were like thin ribbons. Her pain now never left her day nor night. On digital examination the rectum at the height of the second sphincter was filled with a nodular growth by which the lumen was almost obliterated. The tip of the finger could barely distinguish the opening. Examination through a Martin's rectal speculum showed the rectum blocked and the lumen reduced to a small slit. There was no ulceration and no discharge. The age of the patient, her anæmia, and her history of several months of gradually increasing trouble caused me to make at once, in my own mind, a diagnosis of cancer of the rectum. I said nothing to her, intending to communicate with her daughter. She begged for some relief and sleep, and morphine seemed inevitable. But first, I thought, I will put the anæsthetic power of the high-frequency to a supreme test. So with her permission I passed a cylindrical vacuum tube as far into the rectum as possible against the growth. She received the full discharge for 20 minutes. She then sat up and told me in sober earnestness that all her pain was gone,

and that all the distress and weight in the lower part of the abdomen had completely vanished. Excepting a restricted diet and oil enemas, she had no other form of treatment. The next day there was a slight return of symptoms and she received another treatment. In the meantime I told her daughter my opinion of the case and advised a consultation with another surgeon, and the submission to an operative procedure if found advisable. Her son in Chicago consulted Dr. Bevan, and came on to Kalamazoo with the intention of taking her to Chicago for treatment. The patient, however, refused to go to Chicago, and insisted on a continuation of the treatments. I advised against delay, but pending her decision continued treatments every other day. The patient began to make a decided gain in general health, and the pains never returned. Defecation became easier and finally normal, and by the time she had taken thirty treatments, no obstruction in the rectum and no growth could be detected. She then consulted Dr. Bevan, who pronounced her free from rectal troubles. I stated to the family that I had been in error in my diagnosis of cancer. But, whatever it was, the result of the high-frequency application transcended anything in my experience.

"Case 7. — In a case of cystitis in a lady of 50, the patient had suffered the usual tortures of that malady for about four months when her case came under my care. Her nights were especially miserable from incessant and painful urination. The alkaline urine contained 50 per cent. of pus, a trace of albumin, but no casts that we could find. Under urotropin a decided improvement was made, but complete relief was a long way off. Hemorrhoids and rectal pains on defecation were also present, and I had her come to my office for high-frequency rectal treatments. After a couple of applications she informed me that her bladder trouble was helped by

the rectal treatments. In order to ascertain whether or not the vesical improvement was due directly to the current or indirectly to the improved rectal conditions, I passed a slender vacuum tube into the bladder itself and run the resonator 15 minutes. The next day I received a telephone message from one of the most grateful patients I ever had. "For the first time in months," she said, "I slept nearly all night and could urinate without pain." The trouble began to return within thirty-six hours, but about twenty more treatments were given which, with the urotropin, brought the case to a favorable termination.

"Case 8. — A case that I had operated upon for dysmenorrhea by dilatation and curettage returned after four months of relief and announced that her old pains had returned to some extent. In spite of verbal encouragement and liquor sedans the trouble rapidly grew worse with each monthly period. The pains would begin shortly before the flow started and continue for three days. She refused to have the operation repeated. One evening the mother telephoned me that her daughter had begun her monthly suffering and asked me to come up and give her something to relieve pain. I asked her to bring her daughter down in a closed carriage and I would see if a new form of treatment would be of any avail. A vacuum tube was inserted so as to lie against the uterus and 15 minutes of the full current given. After 10 minutes the patient declared that her pain had vanished. After the treatment she felt perfectly well, the weight and dragging in the pelvic viscera having disappeared. The pains did not return during that period. With great expectations of a permanent cure I gave her repeated treatments preceding the next period. But the pains began just as before. A single treatment, however, after the onset of the pains, gave complete relief. Further observation fully convinced me that

the pains could not be prevented by any treatment given before the onset of the periodic pains. I have had no opportunity of verifying these results in any other case.

"Case 9.—One case of painful scar on the hand of a fireman is interesting. The pain radiated up the arm and for over a year had been intermittently of great annoyance. I told the patient that an excision of the scar would probably be necessary because of included nerve ends. But first, I said, let me experiment with electricity on that thing. The first treatment of course relieved the pain. I had my assistant give daily treatments to the scar, which became very red. Under a lens fine blood capillaries could be seen ramifying the old scar tissue. After a week's treatment we stopped to permit the inflammation to subside. In a week redness disappeared and the scar, which had been so prominent, was largely absorbed. This was doubtless due in large part to mechanical irritation of the spark and the extraordinary increase of blood supply. The case has remained free of all symptoms."

Crane also removes warts, moles, and corns with the high-frequency spark, one application being usually sufficient for small areas. In the cure of excrescences following X-ray burns on the hands of the operators it is very efficient and may possibly be of service in increasing the vitality of the tissue in X-ray burns.

SOME RESULTS WITH THE HIGH-FREQUENCY CURRENT

Clarence E. Coon, *American Medicine*, March 25, 1905.

Coon's high-frequency apparatus consists of a twelve-plate static machine which excites Leyden jars having 70

square inches of foil on both outer and inner surfaces during dry weather, and 130 square inches during moist weather. To the outer coatings of the jars is attached a "solenoid of ten turns of number seven magnet wire, one meter in circumference, and continuous with this solenoid are 42 turns of number twelve magnet wire, and to the upper extremity of this resonator the electrodes were attached." He runs the machine at 350 revolutions per minute and uses the ordinary high-frequency glass vacuum electrodes. Results of treatment in five cases of neuritis are reported.

The first occurred in a woman, affected the left upper extremity and was accompanied by anæsthesia of the index finger. For several weeks she had been unable to sleep without an opiate and the usual remedies had given no relief. The first two or three high-frequency applications seemed to intensify the pain. Following the fourth there was rapid improvement and in about three weeks the cure was complete. There had been no recurrence ten months after the final treatment.

The second occurred in a woman aged 64 who had had a pain in the right arm and shoulder for 15 years and for several months previously also in the left arm and shoulder. In front of the internal condyle of each arm were tumors about the size of a hen's egg. These tumors were sensitive to pressure which also caused pain to radiate down the forearm. Near the middle of the anterior surface of the forearm were smaller tumors. The ordinary measures had never produced relief in this case, which was diagnosticated as chronic neuritis with neuromas. She was given five treatments with greater freedom from pain than she had experienced in years as a result and the tumors decreased markedly in size. She then announced her attention of continuing electrical treatment in another city and the final result is not given.

The third occurred in a woman aged 33 who had had a sensation in the lower cervical and upper dorsal region, as though the area had been bruised, for years. Occasionally the arm and forearms would feel numb. An area of tenderness upon pressure was present over the spine and surrounding this area for a distance of about two inches on either side was a slight erythema. Various treatments had been applied without beneficial result. She was much relieved after the second high-frequency application and complete cure followed 12 treatments extending over an interval of eight weeks.

The fourth case occurred in a woman aged 25 who for six weeks had suffered with severe pain in various parts of the body. Twenty-four hours after the pain appeared an eruption would come on her skin, showing some signs of vesiculation over the areas affected, which were principally the buttocks, thighs, thorax, and upper extremities. She had not been free from pain at any time for six weeks. Diagnosis of atypic herpes zoster. The first treatment relieved the pain for several hours. Nine treatments extending over a period of about three weeks completely removed the trouble.

Case five was a man aged 65 who, for 20 years, had been troubled with itching at different times unaccompanied by any visible lesion except scratch marks. The only way he could sleep was to saturate his night-clothing with a sedative solution and he had done this about once an hour every night for several weeks. He was treated daily for three months and then was able to sleep most of the night without the lotions. He was relieved of his itching. Although treated for three months this case was not entirely cured.

Two cases of chronic constipation which had existed for several years were very greatly improved. One case of tubercular adenitis on both sides of the neck, the larger of the tumors being an inch in diameter and a number of other

smaller ones being evident along the posterior margin of the sterno-mastoid muscle, showed gratifying results. The blood examination showed hæmoglobin 61 per cent., white corpuscles 13,000. The patient was treated at intervals for six months, by which time all the tumors had disappeared except one which was so small as to be scarcely discernible.

Another case of tubercular adenitis occurring in a young girl and recurring four years after a radical operation for the removal of cervical glands, is also reported. These glands would frequently enlarge, suppurate, and after opening would be very slow to heal; as a consequence sinuses were almost constantly present somewhere in the neck. When she came under Dr. Coon's care there was a sinus about an inch in depth on the right side of the neck; this was entirely healed by four treatments. She was treated irregularly for about seven months, at which time she had entirely recovered and had remained so for five months at the time the report was published. A case of chronic rheumatism is also reported which was practically entirely cured by these applications.

Dr. Coon considers the current very valuable for healing sluggish ulcers, and has had some gratifying results with it in an incipient tuberculosis; one patient increased 12 pounds in weight in three weeks, the cough lessened and the patient became so much improved that she believed she had recovered and discontinued treatment.

In chronic constipation the high-frequency current is believed to constitute a measure of considerable prominence.

It is to be regretted that the technique employed by Dr. Coon was not described.

CHRONIC RHEUMATISM, GOUT, AND OTHER URIC ACID DIA- THESES TREATED BY THE X-RAY, HIGH FREQUENCY CURRENTS, AND VIBRATORY MASSAGE

Sinclair Tousey, *Medical Record*, March 4, 1905.

The X-ray is applied only locally and only in the few cases in which a single joint or nerve proves resistant to the other measures; it does not form a part of Tousey's "Uric Acid Technique," but is a most valuable adjunct in some cases. An eight or twelve inch coil is used with a liquid interrupter. Four amperes of primary current, a Müller heavy anode tube of three inch spark resistance and a penetration of three or four layers of the tin foil of the author's radiometer; the tin foil weighs an ounce to one hundred square inches. The distance from the anti-cathode to the nearest cutaneous surface is nine inches and the exposure three to five minutes twice a week. A Friedlander shield is used to protect the operator and all parts of the patient except an area five inches in diameter where the treatment is required. The effect is anodyne and resolvent. No reaction is excited in the skin.

The "Uric Acid Technique" consists in the application of vibratory massage up and down the spine and over the abdomen for about ten minutes, twice a week, and the application of high frequency currents for about fifteen minutes on the same days and over the same regions, but in addition locally over the affected joints or nerves.

The vibrator used was made by Wappler; it has a 1/16 horse power motor, a flexible shaft and a ball extremity in which an excentric weight revolves. The ball is applied laterally so as to get a tapping effect with short rapid strokes and the effect is regulated according to the case.

The high-frequency currents were applied by means of a d'Arsonval transformer (X-ray coil, liquid interrupter,

two very large Leyden jars, solenoid, metallic electrode held by the patient, and glass vacuum electrode held by the author's completely insulated handle). Using a twelve inch X-ray coil the primary current is from five to eight amperes and the spark gap of the transformer from a third to half an inch. The effect is the application to the patient of a heavy current producing a great deal of warmth but no sparking. The new handle referred to is of hard rubber which extends an inch beyond the metallic socket into which the shaft of the vacuum electrode screws, so that the glass tube itself is the only uninsulated portion of the apparatus that comes anywhere near the operator or patient. It enables the application to be made in the most inconvenient locations without the risk of giving the patient a shock from the metallic part. Where metallic contact is made with the glass tube there is a wire passing through the wall of the latter and practically sealed. This allows the high tension current to enter the vacuum of the tube without the undue heating of the glass which would otherwise result from the use of a small surface of contact and powerful currents.

The effect of high-frequency currents applied in this way is complex; ten thousand waves of ultra-violet light pass into the body each minute, a certain amount of ozone is generated upon the surface and carried in by the current, and an interrupted current of about a hundred milliamperes passes through the body. The greatest effects are local about the vacuum electrode, but there are marked constitutional effects in different diatheses. The Oudin resonator and unipolar application seems more especially suited to cases in which a brush discharge is indicated. It was not used in any of the cases alluded to in this paper.

The vibratory massage produces an increase in the superficial circulation and an excitation of nerve function, or if the

pressure is deep and prolonged an inhibition of nerve function. It stimulates the circulation and functional activity of every viscus over which it is applied; and improving the action of the stomach, liver, intestines, and kidneys it is easy to understand the benefit produced by its application over the abdomen. Applied along the spine its action is reflex, but has proven in many cases easily demonstrable.

If the contact is made perfect, as by the use of a dusting powder, the high-frequency currents produce no sparking, merely a sensation of warmth. No sensation at all like that from faradic electricity or the static spark, and with the usual bipolar application no muscular contraction. There is a slight increase in the cutaneous circulation and a sense of exhilaration which used to cause one patient to feel like walking all the way home to Seabright, N. J. The observations of d'Arsonval, Berlioz and others are quoted as showing an increase in the amount of urine and in the amount of urea, uric acid and other solid ingredients contained therein, also an increase in the amount of oehæmoglobin in the blood, but Freund is quoted as saying that these observations have not been generally confirmed.

In the cases reported the beneficial effect was reflected in the urine as well as in the other symptoms. There was no noticeable effect upon the temperature during the treatment. The effect of the high-frequency currents is apparently due partly to a counter-irritant action increasing surface circulation, and partly to a reflex action through the nerve supply of the different organs of assimilation and elimination.

Case 1. — Man aged 54 with a family history in which occurred rheumatism (fatal in his father's case at thirty-nine), "ossification of the heart," paralysis of the throat, and apoplexy on the paternal side, all of them being large

men. On his mother's side they were all delicate and died at an early age without special diatheses. He himself is 54, has had no sickness since childhood except inflammatory rheumatism, which kept him in bed for a month, maximum temperature 103.8° F. Present trouble dates from an attack of lumbago two years ago. Not sick in bed, but any movement was very painful in the morning, with gradual improvement through each day. The symptoms disappeared in about two months. Status praesens, six feet four inches in height, and weighs one hundred and seventy-eight pounds, some flat-foot and consequently extraordinary breadth to the ball of the foot. Right great toe joint is swollen and stiff and there is a gouty pain in it, especially on awakening. The middle toe of the right foot has a sensation as of slipping out of joint. The right hand has a rheumatic pain. These symptoms have remained so aggravated in spite of medical treatment as to threaten to incapacitate him for business. Shortly after beginning treatment he had a fall, producing a severe ecchymosis of the left thigh, followed by stiffness of the knees and an added rheumatic pain in the left hand.

Treatment consisted in the high-frequency currents and vibratory massage twice a week, according to the author's Uric Acid Technique, and the administration of ten grains of salophen three times a day, the avoidance of tea, coffee, and tobacco, and the application of flat-foot braces. At the end of a month the gouty pain in the right great toe had almost disappeared, the stiffness and crick in the knee had been reduced two-thirds, the sensation as of the middle toe slipping out of joint had almost gone. Only a trace remained of the rheumatic sensation in the right hand, and the rheumatic pain in the left hand, brought on by the fall, had been reduced three-fourths. After another two weeks'

treatment the patient reported himself so well in every way that it seemed proper to discontinue treatment.

This case is typical of a large number. The effect of the first treatment is to bring them up from their lowest to their best condition and this takes place before they have had the prescription for salophen filled. During the next two or three weeks this improvement is maintained, but no further improvement takes place; then quite suddenly a progressive advance begins and in a few weeks the case is cured.

Case 2.— A woman of 54, weighing two hundred and eighty-seven pounds, and a family history of rheumatic gout making them chair invalids for years. Personally she has always been careful about diet, but has gradually become more and more affected by a rheumatic or gouty condition which, in spite of medical treatment, has finally almost crippled her. For some time past she has not been able to walk more than two or three blocks, and on coming to a curbstone would hesitate for some time before attempting to step up those two or three inches. The knees were badly swollen, the joints of both feet were stiff and swollen, as was also the middle finger of the right hand. The day following the first treatment she was walking any number of blocks, going up and down stairs, and "feeling like a bird." This was before she had begun taking salophen, ten grains three times a day, which is the only suggestion I commonly make concerning medication in these cases.

The original brilliant improvement remained but was not surpassed until after two or three weeks of treatment twice a week. Then she started in to make a steady advance. The locations exhibiting the slowest progress were one knee, which she had strained some time previously, and the middle finger of the right hand. To these several applications of the X-ray were made. The pa-

tient was under treatment from November 10, 1903, to March 20, 1904. At the latter date she seemed perfectly well, although there still remained a little enlargement of the joint of the middle finger. Now, many months after the cessation of treatment, she reports continual increase in health and strength and thinks that the greatest benefit has come since the course of treatment was finished. This answers the question often asked as to whether the benefit is not merely temporary and whether the treatment does not have to be continued indefinitely.

HIGH FREQUENCY, HIGH POTENTIAL CURRENTS, AND X-RADIATION IN THE TREATMENT OF EPILEPSY

Samuel G. Tracy, *N. Y. Med. Journal and Phila. Med. Journal*, March 4, 1905.

Tracy states that there are 12,500 epileptics in New York State, 2,500 of whom are public charges. Under the usual methods of treatment little hope is offered these unfortunates and the cures hitherto have not amounted to more than 8 per cent.

He claims 'his method of treatment has given him better results than the older methods. He calls attention to the value of the bromides, and in certain cases considers its use indispensable, but believes that when used in conjunction with electricity and the X-ray less of the bromide is necessary and in some cases it can be dispensed with entirely.

If the disease is due to alcoholism or fright, a cure may be effected by removing the cause. During the convulsion he places the patient on his back and restrains him moderately, so as to prevent him from injuring himself; the clothing is loosened about the neck and waist and the patient given plenty of fresh air. During the sleeping stage, following the convulsion, he places the patient in a comfortable position and does not

disturb him. When he awakes concentrated nourishment is administered.

Any exciting or reflex cause, such as worms, autointoxication, adherent prepuce, foreign bodies in the ear or nose, naso-pharyngeal polypi, defects of vision, eye strain, injuries to the scalp or skull must be attended to and the removal of such conditions frequently alleviates or cures the disease.

The galvanic and faradaic currents have been used with little success. He quotes Riggs as saying that epilepsy may be considered a paroxysmal discharging disease of the highest nerve center level, as described by Jackson. He considers that the proper application of the high-frequency currents have a remarkable nutritional effect on the brain, thus restoring the nerve centers to their normal function. The effects on the nervous system are marked. Freund states that melancholia and hypochondriasis are benefitted by this treatment as are hysteria and neurasthenia.

Tracy has found that decidedly beneficial effects are obtained in epilepsy by high-frequency currents combined with X-radiation. In some cases these are employed alone, in others 15 to 60 grains a day of the bromide of sodium are administered as a side treatment.

Both *grand* and *petit mal* are treated in much the same manner. Chronic cases do better when the treatment is combined with small doses of bromides. In females double the bromide just before and during the menstrual period. Each patient is treated every other day.

First, five to ten minutes X-ray treat-

ment from a high tube placed 6 to 10 inches above the head. Following this high-frequency currents are applied over the brain for 10 minutes, and for 5 minutes over the spine. When this method is employed in conjunction with small doses of bromide, at least 25 per cent. of the *petit mal* cases may be tentatively cured, 20 per cent. of Jacksonian epilepsy, and 12 per cent. of *grand mal*. All cases treated were improved more or less, both as regarded the frequency and severity of the seizures, and in addition, the general mental and physical condition were much improved. Sufficient time has not elapsed to show how permanent these results will be.

Nevertheless Tracy believes that he is on the right path. He reports several cases showing great improvement under this line of treatment. He believes that the high-frequency currents possess the power of liberating a larger quantity of the bromide as the solution of the salt circulates in the brain, thus smaller doses of the drug have more pronounced effects.

He concludes that in the treatment of epilepsy all reflex disturbances must first be eliminated. In the high-frequency current we have an agent which acts as a nerve sedative, controls local congestion, and promotes the normal functional activity of the nerve centers, and in addition where the bromides are administered this electric modality sets free larger amounts of bromine in those areas of the brain where the lesion of epilepsy is likely to be located.

RADIO-DIAGNOSIS

THE X-RAY IN KIDNEY DISEASE

Louis Gregory Cole, *Medical News*, March 11, 1905.

Within the last year or so improvements in apparatus and technique have rendered it possible to make reliable neg-

ative and positive diagnoses of renal and ureteral calculi, in subjects of moderate size. This is rendered possible by using what Cole designates as "the ray of selective absorption." It is possible to show some renal calculi without this ray,

but such plates are worthless in making a negative diagnosis. Another factor which is apt to produce errors of interpretation of the plate is "fogging the plate by rays that go *around* the patient instead of *through* him."

Cole makes a skiagraph of patients weighing 130 pounds or less by exposing for from 5 to 20 seconds.

As the efficiency of the apparatus increases, the difficulty of interpreting the plate also increases. We have the shadows of bone, muscle, calculi, feces, undigested food in the intestines, calcareous nodules or arteries and tuberculous deposits in the kidney to differentiate. Carcinoma of the lower end of the œsophagus is also said to be observable. Any or all of these conditions might be mistaken for renal or ureteral calculi.

Near the lower end of the ureter there are frequently found shadows which closely resemble ureteral calculi as regards both size and shape. Just what they are has not yet been determined, but the source of error due to their presence should be borne in mind. The size and shape of the calculi should be demonstrable in order that the diagnosis may be complete. Cole locates the tube vertically over the umbilicus and eighteen inches distant from the plate. In order that a negative diagnosis may be relied upon "the spine and transverse process of the lumbar vertebra must show distinctly clear-cut edges all the way to the tip. The last rib and psoas muscle must also show. The kidney and wall of the intestines may show, but are not really necessary for even a negative diagnosis."

In 179 cases he has failed once to show a renal calculus when it was present; this failure was due to the plate not extending high enough to cover the kidney region, and twice he has made a diagnosis of a possible renal calculus where it did not exist. One of these was in a case of a man weighing 217 pounds and the mass was found to be

feces; the other, a woman weighing over 200 pounds, and the shadow was covered by gallstones and carcinomata of the head of the pancreas. In neither of these cases was he able to detect the size or shape of the supposed calculus.

A WARNING AND A PROTECTOR FOR X-RAY WORKERS

Arthur Holding, *Medical Record*, March 25, 1905.

Holding reviews the injuries and dangers to which X-ray workers have been found to be liable, the latest being sexual sterility, and wonders if the next decade will show us as many unexpected dangers as has the last. He states that the liver, spleen, heart, kidneys, intestines, brain, blood, and lymphatic system may prove susceptible to the deleterious action of the X-ray and suggests the advisability of all X-ray workers being thoroughly protected. The ordinary screen and protectors are either cumbersome, inconvenient or inefficient, and he suggests the use of "a lead partition between the operator and the X-ray tube. Such a protector can be arranged by having the switchboard mounted on the side of the X-ray room farthest removed from the X-ray apparatus, and placing a strong oak framed screen, covered with two layers of sheet lead, each 1/16 of an inch thick, between the operator and the X-ray tube. This screen should be about six feet high and three feet wide. A mirror can be arranged on pivot supports at one end of the screen, so that the operator can see the reflection of the fluorescing tube, and need not look directly at it.

"Such a device gives more protection than most X-ray workers have been using in the past. It is too early to say whether it will secure absolute safety for the radiographer."

RADIOTHERAPY

DANGERS FROM THE X-RAY ATMOSPHERE TO THE OPERATOR. THEIR PREVENTION

H. W. Van Allen, *Boston Med. and Surg. Jour.*, March 9, 1905.

Seven patients who had been subjected to repeated radiations several months previously were examined to ascertain whether or not any effect had been produced upon their sexual capacity. All had been rayed in the genital region so that the testicles were exposed to influence, more or less dermatitis had been produced, and all were sexually normal when examined *as far as they knew*. None of them had been rayed for malignant disease and all were in good health when examined. The results were as follows:

Case 1.—Had had twelve treatments four months previously; spermatozoa were found to be present and normal.

Case 2.—Twelve treatments one year previously; spermatozoa normal.

Case 3.—Thirty-five treatments five months previously; *spermatozoa absent*; had had children and no other cause of sterility was discoverable. Age 38 years.

Case 4.—Ten treatments one year previously; spermatozoa normal.

Case 5.—Fifteen treatments four months previously; *spermatozoa absent*. Age 56.

Case 6.—An X-ray tube maker who had not been exposed to the rays for six months; *spermatozoa absent*. Age 42.

Case 7.—Forty-five treatments fourteen months previously; *spermatozoa absent*; had had children. Age 40.

In cases 1, 2, and 4 very decided dermatitis had been provoked, while in cases 3 and 7 scarcely any reaction was present, demonstrating that dermatitis had nothing to do with the absence of

spermatozoa in these cases; their absence occurred in the cases which had had mild exposures for long periods.

Thus the sort of X-ray influence which produces this abnormality is the very one to which the operator is exposed and nearly all X-ray workers of experience show its effects, to a greater or less extent, in the form of dryness and yellowness of the skin, modification of structure in the nails and hair, intestinal indigestion, drowsiness, mental irritability, lack of mental concentrative power, etc. Radiographs are said to demonstrate a prematurely sclerotic condition of arteries in the thinner parts of the body in some cases. It may be that serious structural changes in the internal viscera will ultimately obtain. These are all signs of premature senility and Van Allen believes them to be due to inhibition of cell production "through degeneration of the arterioles. It is in this way that epithelioma yields to its influence. The abundant blood supply needed for its growth is cut off and recovery takes place. In the same way many of the symptoms complained of by the operators are explained."

To protect the X-ray worker it is suggested that all of the X-ray apparatus except the tube, be located in one room, the tube being in a contiguous apartment with the patient. The wall between these rooms should be covered with lead at least $1/32$ inch thick. The wires to excite the tube could be carried through the wall and a hole should also be so located in the wall that the tube could be watched while in action by the operator on the other side of the lead covered wall; this peep-hole should be covered by glass such as is used for cut-glass ware, which contains sometimes as high as 20 per cent. of lead. Another arrangement by which the tube could be

watched would be by arranging mirrors at proper angles over the aperture in the wall.

This arrangement would, of course, not permit of fluoroscopic examination, but the proportion of cases in which fluoroscopy is necessary or advantageous is so small that this is not a factor to be considered, in this connection, as a serious objection.

REMARKS ON THE RESULT OF X-RAY TREATMENT IN SEVERAL CASES OF CARCINOMA OF THE UTERUS

Sinclair Tousey, *New York Medical Journal*,
March 11, 1905.

The first case was that of a large, handsome woman of 50 years who had suffered from an enormous fibroid tumor of the uterus which had finally undergone carcinomatous degeneration of the cervix. There was a profuse sanguineous discharge, a very offensive odor, and great loss of strength. In February, 1903, she had taken ether for the purpose of having the tumor removed, but it was found that the entire pelvis was one carcinomatous mass and that anything like an attempt at extirpation would be immediately fatal. A small portion of the cervix was removed and examination showed it to be carcinoma. She was brought to Dr. Tousey's office for X-ray treatment. The abdomen was found to be distended by the tumor, giving almost the appearance of the completion of gestation. There were very painful and somewhat tender areas corresponding to the positions of the broad ligaments. The vaginal portion of the uterus was cartilaginous to the touch, as were also the anterior vaginal wall, the urethra, and the entire fornix. There was a profuse bloody discharge with offensive odor.

The treatment consisted in allowing the X-ray to shine through the uncovered abdominal wall, and through a

Nott's speculum which has a duck-bill blade posteriorly and two divergent blades anteriorly; and in the application of high-frequency currents over the two painful areas. The current was from the 110 volt direct current. The Caldwell liquid interrupter was used, giving about 10,000 interruptions a minute. An 8 inch coil was used, and the tube was a 40 cm. Gundelach tube, the strength of the primary current being about 4.5 amperes. The vacuum in the tube was adjusted so as to correspond with a resistance of about $2\frac{1}{2}$ inches, and a penetration of two or three layers in the author's radiometer, each layer consisting of tin foil weighing one ounce per 100 square inches. The distance was 9 inches from the anti-cathode of the tube to the nearest surface of the patient, and the time of exposure was about 5 minutes over the abdomen and 5 minutes through the vagina.

The high-frequency currents as used in this particular case were taken directly from one pole of the X-ray coil by means of an insulated cord passing to an insulated handle by which the operator held a glass vacuum electrode. When in operation this tube is filled with 10,000 rays a minute of ultra violet and violet light passing into the patient's tissues and disappearing. A certain amount of ozone is produced and some of this is carried in by the current, while some remains upon the surface.

The result of the treatment was the very prompt disappearance of pain, and of the discharge and odor. There was at first a little general disturbance possibly due to the elimination of morbid products. In the course of four months the fibroid had diminished one-half in size, the discharge, odor, pain, and weakness were things of the past. There was scarcely any change in the cervix and vagina. She was then referred back to her family physician, and continued well and happy for a whole year. At the end of that time she devel-

oped some gastric symptoms and sank very rapidly.

Reviewing the case, the Doctor was confident that the woman's life was prolonged for a year by the X-ray, and during almost all that time she was perfectly comfortable.

Another case was a woman 50 years old, from whom a tremendous fungating mass had been amputated from the cervix and the treatment consisted in allowing the X-ray to shine through the abdominal wall and also applying it directly to the vaginal fornix by means of a treatment tube. In this instrument there is a prolongation directly opposite the anode through which the X-ray passes and which may be introduced through the vagina or other cavity. The entire X-ray tube is constructed of lead glass opaque to the X-ray except at the extremity of the intra-vaginal prolongation. The application over the abdomen was with a 40 cm. tube of medium vacuum and a current of about 4 amperes. It lasted about 5 minutes at a distance of 9 inches from the anti-cathode. The application in the vagina was with a current of about 3 amperes and lasted about 3 minutes. High-frequency currents were also applied over the abdomen and up and down the spine as a tonic.

The treatment was begun October 1, 1903, and was given on an average once a week until December 3, 1903. The effects were diminution of pain and very marked decrease in the amount of the discharge, but the patient's strength steadily failed, and treatment had to be suspended. She died about two or three months later.

Another case was a woman about 35 years old, in whom the discharge and size of the tumor had been kept down and the patient's general appearance improved. A condition almost like that of health has been continued almost for a year. Treatment has been through the abdominal wall and through a vagi-

nal speculum. Mild applications have been made twice a week.

Several other cases are given in detail in which all the symptoms have improved very much; but the treatment does not appear to have actually cured any of them.

He very strongly recommends the adoption of the treatment at any stage before a recurrent cancer has too far sapped the patient's vitality.

THE PRESENT STATUS OF THE ROENTGEN RAY

George Coffin Johnston, *St. Louis Medical Review*, March 18, 1905.

The late advances in the diagnostic use of the X-ray have been principally along the line of more efficient work, the production of better radiographs with shorter exposures and improvements in instrumentation. That it has become an agent of unspeakable value in the diagnosis of obscure conditions is proven by the number of cases of severe hip joint disease in which the radiograph demonstrates pathology of the sacroiliac synchondrosis, "rheumatic ankles" which prove to be osteosarcoma, "tenosynovitis" which prove to be tuberculous osteitis, etc.

The development of radiographic technique in renal calculi has reached a point where a negative finding is entitled to respect, provided the operator is skilled. In a series of 42 cases examined for renal calculi by Johnston no error has been made as far as is at present known. In 16 of these cases calculi were diagnosticated radiographically and removed surgically. In six of them operation was refused, hence the radiographic finding has not been confirmed. In one case of small stone in the ureter the stone was passed on the night following the examination. In one case wherein was present a quantity of cal-

careous material in the bladder of a very obese subject the radiograph failed to show it. The calcareous material was removed later by crushing and washing out. The personal factor in the equation of radiographic reliability is considered to have a value of 100 per cent.

Whereas gallstones have been found and a positive diagnosis is reliable, a negative diagnosis cannot at present be considered conclusive.

Johnston has invented a fluoroscope consisting of a box which holds the tube in a fixed position. This box is X-ray proof and so constructed as to permit of the passage through a special window of a pyramid of rays which, at a distance of ten inches from the tube, is just 8x10 inches at the base. "At this point, then, the screen of the fluoroscope is introduced, and the X-ray field is just large enough to illuminate fully the screen, instead of half as in the old method. The fluoroscope is of a new construction, radically different from the old instrument, which consists of a "reflecting mirror set at an angle of 45 degrees to the fluorescent screen and reflecting the image on the screen to the eyes of the examiner, who is stationed at the side of the tube, totally removed from the field of X-ray influence." By the use of this device the operator does not need to fear the production of burns.

Johnston considers that the treatment of acne, sycosis, eczema, and lupus is complete only when this agent is used, and that superior results are obtained in these conditions to those secured by any other agent. The great trouble is that few men can afford a proper grade of apparatus, and fewer will give the time and trouble necessary to learn how to use it properly.

In malignant growths it is very efficient in preventing recurrence, and the treatment should be applied as soon as the state of convalescence is established; it is also recommended that a "few hard radiations" be administered over the site

of operation and a considerable distance beyond it, before removal. Johnston has seen excellent results follow operations when this has been done, upon cases which were so hopeless that extirpation would not have been undertaken by a surgeon but for the promise held out by the X-ray. In sarcoma many good results in cases which would otherwise have been hopelessly doomed to early death have been obtained.

As regards treatment of tuberculosis Johnston says:

"The treatment of the various forms of tuberculous skin, bone, and joint disease is very satisfactory and certain and here the X-ray has undoubtedly done wonderful work. In the treatment of pulmonary tuberculosis the results are fair, but not better than under many other older methods."

He concludes as follows:

"1st. The X-ray is today a more useful adjunct to medicine and surgery than at any time since its discovery.

"2d. Its employment today requires a higher degree of skill than of old.

"3d. As a remedial agent its use is becoming more circumscribed as to the number of conditions treated, but these are better treated.

"4th. Its place is that of skilled assistant to the surgeon.

"5th. Its general value, *post operationem*, to prevent recurrence of malignancy, is admitted but its limitations here are yet undefined.

"6th. Radiotherapy is the practice of both medicine and surgery, and must be confined strictly to the profession.

"7th. The present friendly attitude of the surgeon promises well for the advancement of scientific X-ray work, and better results in the surgery of malignancy."

THE VALUE OF RADIOTHERAPY IN GLANDULAR AND CUTANEOUS DISEASES

Russel H. Boggs, *St. Louis Medical Review*,
March 18, 1905.

Sufficient work has now been done to determine pretty thoroughly the value of the Roentgen rays as therapeutic agents in certain diseases, and those who have made a careful study of X-ray therapy realize and appreciate their value in these diseases. In some cases cures result, in others only benefit, but positive results are more convincing than negative and failures can frequently be accounted for by lack of experience and skill on the part of the operator or the hopelessly advanced condition of the disease when the patient came under treatment.

While many skin lesions can be cured by this method, it is unwise to apply it to the trivial affections which can be cured by other methods much less expensively. The differences of opinion existing among dermatologists as to the value of Roentgen therapy are probably due to differences in technique employed by the different operators. "The Roentgen rays must be prescribed and given in a therapeutic dose for each disease, in order to produce results. The dosage depends upon the quality and quantity absorbed, and one of these factors is equally important with the other in giving a therapeutic dose; to do the most successful work, they must be varied to suit each individual case.

"It is a well known fact that tissues are not always affected to the same extent by the same dose, any more than the same dose of a drug will always produce the same physiological action. But by studying the patient and the disease, just as before prescribing drugs, almost as uniform results in producing reactions can be obtained."

Boggs does not believe that idiosyncrasy is frequently a cause of excessive

dermatitis, but a diseased area will react more readily than normal tissue simply because the vitality of the cells is lower. If it requires 100 units of X-radiation to cause reaction in a certain diseased area it may be safely assumed that it will require 200 units to produce the same degree of reaction in healthy areas. If the dose is very small stimulation takes place, whereby nutrition is increased, but if the dosage is larger atrophy and degeneration will follow as a result of excessive stimulation.

Acne constitutes a disease of considerable prominence in connection with X-ray therapy because it is so often extremely resistant to the older methods. The rays give uniformly better results than curettage or incision, which alone is amply sufficient to justify the treatment of all cases of the pustular type by the X-ray; it is not, however, always necessary or desirable to treat acne of the milder form by this method. He considers that the X-ray cures acne by inducing a leucocytosis. Seventy-five per cent. of all cases of acne can be cured without producing dermatitis, but in the other twenty-five it will be necessary to provoke reaction to the degree of peeling produced by severe sunburn. Boggs believes that cases cured without the production of a reaction are much more apt to recur than those in which the application has been severe enough to be followed by peeling of the skin.

In lupus no other agents can be compared to the X-ray and Finsen light as regards efficiency. In Europe the Finsen light is the favorite, while in this country the X-ray is most used. The method of using it in the different countries is probably responsible for the different preferences. The X-ray produces quicker results than the Finsen light, and Boggs usually begins the treatment of these cases with the X-ray, continuing the same until a slight dermatitis is produced, and then substitutes the Finsen light. He thinks that time is

thus saved and that the results obtained are better. Cases of lupus vulgaris that cannot be so cured are either not treated for a sufficient length of time or the disease is very extensive, involving deeper tissues and the patient not in a healthy physical condition. He advocates continuing treatment for some time after all visible signs of the disease have disappeared, giving enough treatment to produce a slight redness again. When this plan has been followed out in his practice he has seen no recurrence.

A few cases have been reported of Hodgkins's disease as cured, and the hopelessness of this condition under ordinary treatment renders it justifiable to give these patients the benefit of what good the X-ray will do. A remarkable improvement of the general condition almost always follows after only a few radiations.

A few cases of goitre have responded readily to the X-ray when all other forms of treatment had failed. In some of his cases the growth has been reduced only one-half, but the symptoms of the disease have disappeared, and he considers this sufficient evidence to justify subjecting these patients to this treatment.

As illustrating the comparative curative effects of surgery and the X-ray in cancer he quotes from Dr. Hulst, who compared these effects to the results obtained by shoveling snow from a sidewalk. No matter how thoroughly the shovel had been used still there remained in the cracks a small amount of snow. This snow can be removed by means of salt. The surgical operation may be likened to the shoveling of the snow and radiotherapy to the sprinkling of the salt. He concludes as follows:

"1. It is necessary to distinguish between the diseases which should, and those which should not, be treated by the X-ray.

"2. While the continual cry of technic may become tiresome to some who think the subject can be mastered in a

few days or a couple of months, the method of application of the rays and the judgment of the operator account largely for successful or unsuccessful work.

"3. It is just as essential to administer a therapeutic dose, when applying the Roentgen rays, as it is when prescribing powerful drugs.

"4. Idiosyncrasy is not a frequent cause of excessive dermatitis.

"5. A dosage that causes stimulation of healthy tissues will usually produce a slight reaction in diseased tissue.

"6. At all times it should be remembered that it is not so much the X-ray that cures, as the judgment with which the rays are employed.

"7. The X-ray is one of the best therapeutic agents known for the treatment of acne and many other skin diseases, but it is unnecessary in many instances to treat the trivial and less obstinate cases by this method.

"8. The X-ray, supplemented by the Finsen light, is the most efficient therapeutic agent for the treatment of lupus.

"9. The X-ray is the most efficient agent for the treatment of certain tuberculous glands, Hodgkin's disease, and selected cases of goitre.

"10. Unless the operator has had a wide experience in the treatment of carcinoma, he should always consult a surgeon in each case, as it is certainly by the combination of surgery and X-ray that the best results can be obtained."

RADIOTHERAPY AND SURGERY, WITH A PLEA FOR PREOPERATIVE RADIATIONS

William J. Morton, *Medical Record*, March 25, 1905.

Attention is called to the fact that if X-rays are applied mildly stimulation results: if excessively, degeneration and necrosis. Previously it was recommended to apply X-rays to epithelioma

so extensively as to produce a "caustic effect" or a severe dermatitis; today only a mild dermatitis for the first series of sittings is allowable. Radiation used to be carried over a period of several months, but now a maximum effect is secured in from 4 to 6 weeks, and then an interval of half that period allowed to intervene before treatment is resumed. If treatment of a facial epithelioma is continued after it has fairly cicatrized the whole area is very apt to break down and produce a condition worse than the first; hence the rays should be stopped when the case appears to be cured. Morton prefers to use a hard tube, not less than 5-inch spark resistance, three or four amperes in the primary circuit at 60 volts, anode nine inches from the lesion, and an exposure of 18 minutes three or four times weekly. By following this plan he believes a serious burn is impossible.

Two cases of rodent ulcer which recovered under X-radiation are reported. The first was a woman aged 57, in whom the process had begun ten years previously. During this time she had been subjected to all sorts of treatment, the last having been an extensive operative ablation. The ulcerative process had been and was rapidly progressing; it showed hard infiltration in places. Patient was put upon fluorescin, six drops of an aqueous solution, three times a day, and X-ray treatments. The pain diminished at once and in two months process had entirely disappeared.

The second was a woman aged 52, who exhibited an ulcerated tumor over the left temple $1\frac{1}{4}$ inches in diameter and raised up above the level of the healthy skin about $\frac{1}{3}$ of an inch. Microscopical examination demonstrated it to be a rodent ulcer (superficial epithelioma). About ten weeks of treatment produced complete disappearance.

Case three was a malignant tumor $1\frac{1}{4}$ inches in diameter lifted about a quarter of an inch above the surrounding skin,

occurring on the left cheek under the eye of a man 60 years old. He was radiated at intervals for a period of five months with entire cure as a result. Microscopical examination showed the "cancer nests" characteristic of epithelioma.

When seen early Morton believes that epithelioma involving the lymphatic glands and deeper structures of the face, neck, tongue, and throat, can be cured, and cites, as demonstrating this fact, the case of a physician 55 years old who consulted him for an ulcer upon the tongue. This patient had been advised by two or three surgeons of high repute to submit to surgical ablation, but at Dr. Morton's request the patient refrained and allowed continuance of the X-ray and radium applications. Complete cure resulted in two months.

Some cases of extensive sarcoma which have been cured by X-rays have been reported, but more failures. It is believed that there is ground for hope in this direction.

If primary carcinoma of the breast is seen early a cure may be effected by X-ray therapy, even though the lymphatics are indurated and swollen glands exist in the axilla. Other types of mammary cancer on the other hand will proceed to the formation of metastases in spite of any amount of radiation. Other tumors in this situation, again, will be diminished to a great extent, but a hard, clearly defined mass will persist in spite of radiation, and this should be removed surgically.

Morton believes that the best treatment of cancer is to combine ablative surgery, X-rays, and radium radiation, and his invariable practice is to apply X-ray and radium radiations thoroughly about eight weeks before operation and apply after operation for about the same period. Action is carried just short of producing a mild dermatitis. He bases his belief upon the fact that outlying areas of cancer infection are rendered

healthy, and that pre-operative raying does strongly localize the trouble, upon the following:

"1. By the facts of the observed effect in many cases of recurrent cancer of the skin where this actual fact may be visibly studied and may be verified by palpation. Nothing is more common in the history of radiation than to see large areas of skin-infected carcinoma clear up, leaving a healthy skin.

"2. By the early cure of recurrent cancer in cicatrices.

"3. By observation of the behavior of cancer of the mucous membrane, where under radiation a distinct line of demarcation unfolds itself between the affected and the sound mucous membrane, and by that sign affords a new indication to the surgeon of where to incise.

"4. By palpation of indurated lymphatic vessels in breast cancer. Take a concrete instance of this alone. What surgeon would prefer to cut through infiltrated lymphatics, when he could later on cut through flexible and disinfected lymphatics?"

Confirmatory of his belief that malignant processes are localized and separated, by a line of demarcation, from healthy tissues, he reports a case of epithelioma of the posterior region of the tongue and involving the velum palati. Five days after radiations were commenced, after three treatments, he observed that a serpentine line of demarcation had appeared on the mucous membrane of the hard palate separating the healthy tissues from the diseased ones. The red, dusky inflammatory tissue ended sharply at this line and from it onward the mucous membrane had now assumed a light colored pink and healthy tone. Such demarcation is very helpful to the surgeon in determining how much tissue to remove. Morton believes that pre-operative X-radiation of cancer should precede every operation with as much reason and force as pre-operative

aseptic or antiseptic cleansing of the skin to be incised, and that an early X-ray treatment is the most important thing for the patient as well as early operation. A case that would be curable by operation, also is as likely to be curable by radiation. With those that were curable by radiation the operation would not of course be necessary, and if the X-ray failed in a reasonable time then the patient would be in better condition than before to submit to operation. He concludes as follows:

"1. Radiation treatment exerts a retarding effect upon the growth of some cancers.

"2. It cures some cases—the ratio to operative measures is not here discussed.

"3. Pre-operative radiation will increase the ratio of cures by operation.

"4. Pre-operative radiation transforms some inoperable cases into operable cases.

"5. Pre-operative radiation is recommended as a precautionary measure, probably quite as important as pre-operative antiseptic preparation for surgical operation."

X-RAY TREATMENT OF CUTANEOUS EPITHELIOMA

C. M. Williams, *American Journal of the Medical Sciences*, March, 1905.

This report is stated by the author to be intended, especially, as a contribution to knowledge concerning the liability of a recurrence of cutaneous epitheliomata which have disappeared under Roentgen radiation; 18 cases are fully described, as regards both their behavior under radiation and their condition afterward up to the date of publication.

Of the total 18 cases, one died of some intercurrent disease; four were so irregular in their attendance or under treatment so short a time that conclusive

judgment as to what the ray was capable of was not possible; one showed no improvement after having been treated a month; in one case the condition was improved, but the lesion did not entirely disappear; and in another the lesion disappeared, but, recurred seven months later. Ten cases were apparently entirely cured, and none of them had exhibited any indication of recurrence after periods of four to eighteen months.

The case that showed no improvement was a rapidly-growing epithelioma of the lower lip, a type which is believed to respond reluctantly to Roentgen radiation as a rule. That lip cancers do recover under radiation, however, is proven by the fact that one of the cured cases of this series was such a lesion.

The case in which the lesion improved but did not entirely disappear exhibited a characteristic also present in other cases which were difficult to influence favorably, viz., there was present a mass of almost stony hardness, deep in the skin and subcutaneous tissue, covered wholly or in part by apparently normal epithelium, and exhibiting little tendency toward ulceration; if an ulcer is present it heals readily, but the hard mass underneath is affected but little or not at all. Williams believes that such cases require very vigorous treatment, and that some of them will not yield even then unless an ulcer is produced.

Concerning technique Williams states as follows:

"I. The distance between the tube and the lesion should be made as short as is consistent with the avoidance of sparking from the apparatus to the patient. In treating a large area, like an extensive psoriasis, this rule does not hold. With a small lesion, as is usually the case in epithelioma, it reduces the time of exposure very materially; for since the quantity of rays received on a given surface varies inversely as the square of the distance between that surface and the anode, it follows that an

exposure of four minutes at four inches is equivalent to one of twenty-five minutes at ten inches.

"2. The screen used to protect the normal parts need not be entirely opaque to the X-rays. I have used ordinary rubber sheeting, folded into three layers, and have repeatedly carried the treatment to the production of a moist dermatitis of the exposed area, while the parts covered by the shield remained entirely unaffected. This seemed to show that the rays which affect the skin have very little power of penetration. The advantages of this material are the ease of manipulation and the avoidance of the disagreeable tingling so often noticed when lead is used."

METHODS AND APPARATUS FOR THE MEASUREMENT OF RADIO-ACTIVITY

C. Cheneveau, *Le Radium*, December, 1904.

The subject is discussed under seven sections, setting forth in detail most of the methods that have been successfully employed in the quantitative determination of radioactivity.

I. The photographic method is spoken of as rather uncertain except for qualitative test from a mineralogical point of view. The most sensitive effect of radioactive substances is the power they have of rendering conducting the air in their vicinity. Most of the active meters yet devised depend on this principle.

II. The construction of the well-known Curie electroscope is given in detail, the principle of which is the erection and rate of collapse of a single, thin, metal leaf. The charged instrument is discharged slowly or rapidly, according to the quantity and power of the sample under test.

III. The "electrometric method" is the name applied to that method depending on the well-known behavior of quartz

under stress. The electrification developed by the quartz is proportionate to the applied stress in the form of known weights, and hence if this is opposed to the action produced by the active substance, and a balance brought about by suitably adjusting the weights, the latter readily furnishes a measure of the activity of the specimen.

IV. In this section more sensitive electrometers are described, suitable for the detection and measurement of even traces of activity. The Kelvin quadrant electrometer, as modified by the Curies and by Dolezolek, is described and recommended for this work. The needle is very light and suspended, in the Curie type, by a fine platinum filament serving for a conductor as well as for furnishing the required feeble torque to balance the electric force movement. The dimensions of a convenient and efficient instru-

ment are given with great detail. In the Dolezolek type the suspension is a quartz filament sometimes silvered.

V. In this section a more complicated instrument, depending on the "piezo" quartz principle, is described in detail. The arrangement is due to the Curies, and furnishes far more exact quantitative results than the simple device spoken of in section III. A simple formula,

$$q = 0.063 \frac{L}{E} F,$$

gives the constant charge developed by the quartz under the stress, F , L , and E being constants of the instrument.

VI. VII. Here are described more in detail certain important parts of the electrometers, *e. g.*, the condensing plates for receiving the active material, a convenient form of small storage cells for charging to constant known potential the instruments when in use, etc.

AERO-THERAPY.

LIQUID AIR AND ITS POSSIBILITIES

Samuel G. Tracy, *The Medical Brief*, February, 1905.

The liquefaction of gases has occupied the attention of scientists for over a century. The first gas liquefied was chlorine. This was accomplished under pressure, in 1806, by Northman. Since then various physicists have accomplished the feat with various gases, but the liquefaction of air was not accomplished until 1883, by Wroblewski. It was not furnished for practical purposes, however, until 1892, by Professor James Dewar. Its price today is \$10.00 per gallon, as made by the Tripler system in New York city.

The process of its manufacture is as follows: "The natural air is compressed to the extent of 2,000 to 2,400 pounds to the square inch. This is allowed to escape and pass through certain

small openings, each protected by its own valve, into tubes which coil upon themselves, over and over again, thus cooling off the air more and more as it enters the liquid. The cooled compressed air is now allowed to escape into a vacuum, and a sudden and extreme expansion results. By this method the two necessary conditions are obtained to produce liquid air, namely, critical temperature" (or the temperature at which a gas liquefies, 220°F. below zero in the case of air when the critical pressure is also applied) "and critical pressure" (tension at which a gas liquefies). "The liquid air may now be drawn from the liquefier just as water is from a faucet, and its appearance is like that drawn from the hot water faucet, boiling and steaming."

Even when it became possible to make liquid air at a comparatively inexpensive rate, its usefulness would have been limited, and, in fact, of no avail in medicine

and surgery except for the invention of a bulb by Dewar. This bulb is known as Dewar's bulb, and is used to hold this extraordinary product. It is a glass vessel, with two walls. The space between is exhausted to high vacuum. When liquid air is contained in one of these bulbs it evaporates at one-fifth the rate it does in an ordinary glass receptacle. Later Dewar found that when the inner and outer wall were coated with a bright deposit of silver the evaporation was only one-sixth that from an ordinary vessel. Even with these Dewar bulbs, the proposition to sell the product to physicians does not seem attractive to the manufacturer, because of evaporation and because the bulbs are easily broken and cost from \$3.75 to \$12.00 apiece.

Physiological effect. "When liquid air is applied to the skin and tissues of the body, the parts are immediately frozen. The solidity of the tissues depends on the amount of liquid air used and the length of exposure. The result of this application is, first, anæmia of the part, followed by reddish reaction or slight inflammation. Then, if the freezing has been severe, there occurs a bulla, involving a smaller or larger area, depending upon the length of application." Liquid air "is not only a local anæsthetic, but much or little anæsthesia can be produced with it in a few seconds' time. The anæsthesia lasts longer and is followed by less sloughing than any other freezing mixture. There is slight pain attending its application as an anæsthetic. After the degree of anæsthesia has been obtained, a minute or more should elapse, as the tissue may be too hard for satisfactory operative procedure."

Liquid air is applied with a swab, a flat wooden applicator about eight or ten inches long, on the end of which is wound

some absorbent cotton. This applicator is dipped into the liquid, then shaken to remove the excess of this extremely cold fluid, and applied with firm pressure to the area to be treated. The application should last from twenty to sixty seconds, depending on the tissues to be affected. In many cases it is well not to treat more than a square inch of surface at one application. These treatments may be repeated from twice a week to once in two weeks, the frequency of the application depending upon the amount of reaction induced.

The histories of several cases of epithelioma and nævus which were treated with success by liquid air are related. In lupus erythematosus, where the lesion is not too large, liquid air has proved more satisfactory than any other remedial agent.

As a résumé of the uses of liquid air, he says that:

"First—It acts as a local anæsthetic.

"Second—It reduces inflammation when cold is indicated.

"Third—Stronger, more frequent applications produce stimulation and inflammation of the parts, producing a slough, by causing an obliterating endarteritis, and the destruction of nerve supply.

"Fourth—Liquid air has a selective action for diseased tissue on account of its low vitality.

"From the physical and physiological action of this new and remarkable therapeutic agent, it certainly appears to be worth while to make use of it, in such conditions as lupus erythematosus, superficial epithelioma, some cases of scirrhous cancer of the breast, indolent ulcers, abscesses, and particularly in the various forms of nævi."

The most spectacular results have been attained in cases of cavernous or impigmented nævi.

Special Number

In Honor of the Tenth Anniversary of the Discovery
of the Roentgen Ray



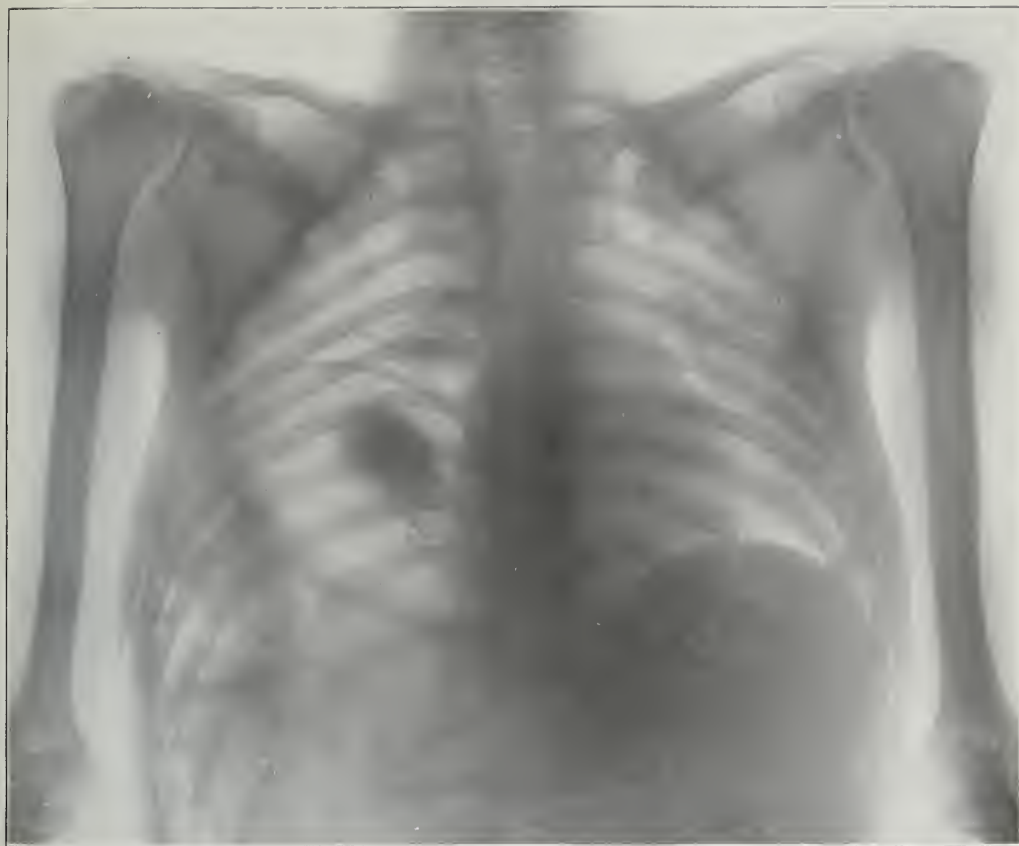
WILHELM KONRAD ROENTGEN

The Archives of Physiological Therapy
May, 1905



This arm was treated by some of the most eminent men in the world for rheumatism. The X-ray showed sarcoma of the bone to be the trouble, after all other diagnostic methods had failed.

By Dr. Gordon G. Burdick, Chicago, Illinois.



This skiagraph was taken post-mortem in 1902, the patient in the supine position. A portable 7-inch coil was used, exciting a medium vacuum tube at a distance of 18 inches from the plate; exposure $2\frac{1}{2}$ minutes. Skiagraph shows the following:

1. The left side of the diaphragm 4 inches higher than the right.
2. The heart displaced to the right.
3. The outline of the stomach, below the diaphragm, containing a bolus of food.
4. The descending colon, showing the transverse folds.
5. The coils of the small intestines, showing a line of feces extending downward in one of them.
6. Shadows of congestion of the lungs.
7. The vertebræ, ribs, clavicle, and scapula.
8. The skin, subcutaneous tissue, the deltoid, biceps, brachialis, and triceps muscles.
9. The humerus, showing the medullary cavity and striations upon the bone.

By Dr. G. E. Pfahler, Philadelphia, Pennsylvania.



Hydro-Pneumo-Thorax and tuberculosis. Skiagraph of patient taken with 15-inch coil, medium vacuum tube at 15 inches distance from plate. Exposure $2\frac{1}{2}$ minutes.

Points of interest are as follows:

1. Light area on the left side indicating the pneumo-thorax.
2. Shadow of fluid at the bottom, about two inches above the diaphragm.
3. Compression of the left lung, with cavities (C. C. C.) at the apex.
4. Shadow of heart and aorta seen in the left chest.
5. Tubercular deposits in the right lung with cavity at the apex.

By Dr. G. E. Pfahler, Philadelphia, Pennsylvania.



Stone in Kidney (outline of kidney plainly visible).

Skiagraphed with a Skala Walter tube, No. 6; anode 18 inches from plate; 16-inch coil with mechanical interrupter (Fuchs' system); 6 minutes exposure; and table lead diaphragm (Fuchs).

By Dr. W. C. Fuchs, Chicago, Illinois.



Stone in the extra-pelvic portion of the ureter.
The same technique as employed with the preceding plate.
By Dr. W. C. Fuchs, Chicago, Illinois.



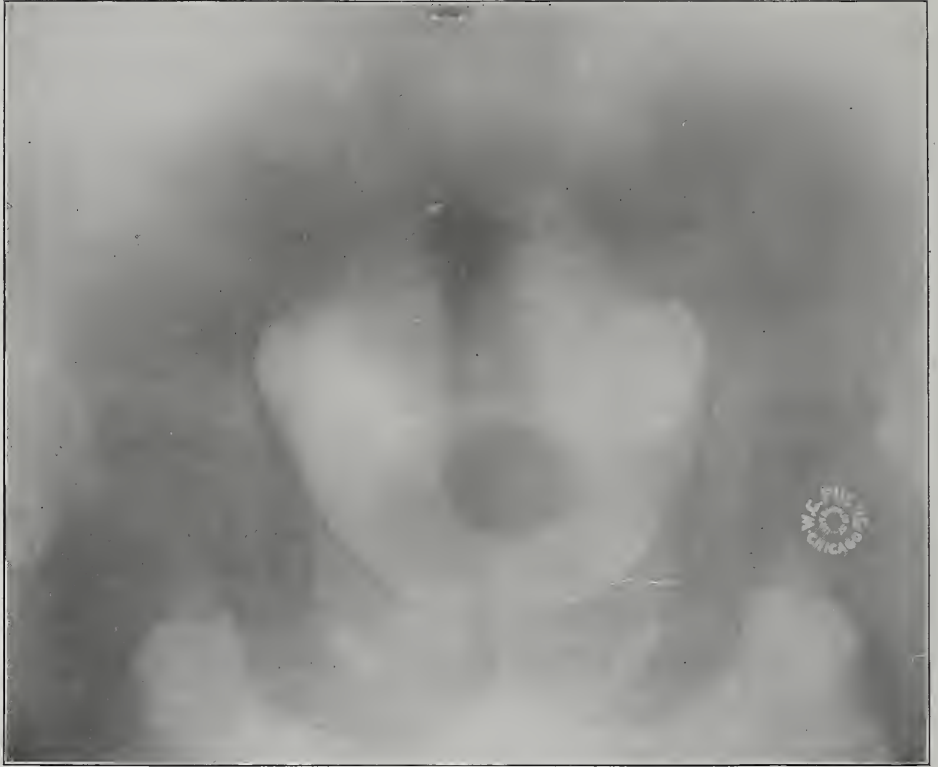
Stone in the intra-pelvic portion of the ureter.

The same technique as employed with the preceding plates.

By Dr. W. C. Fuchs, Chicago, Illinois.

Special Plate XIX

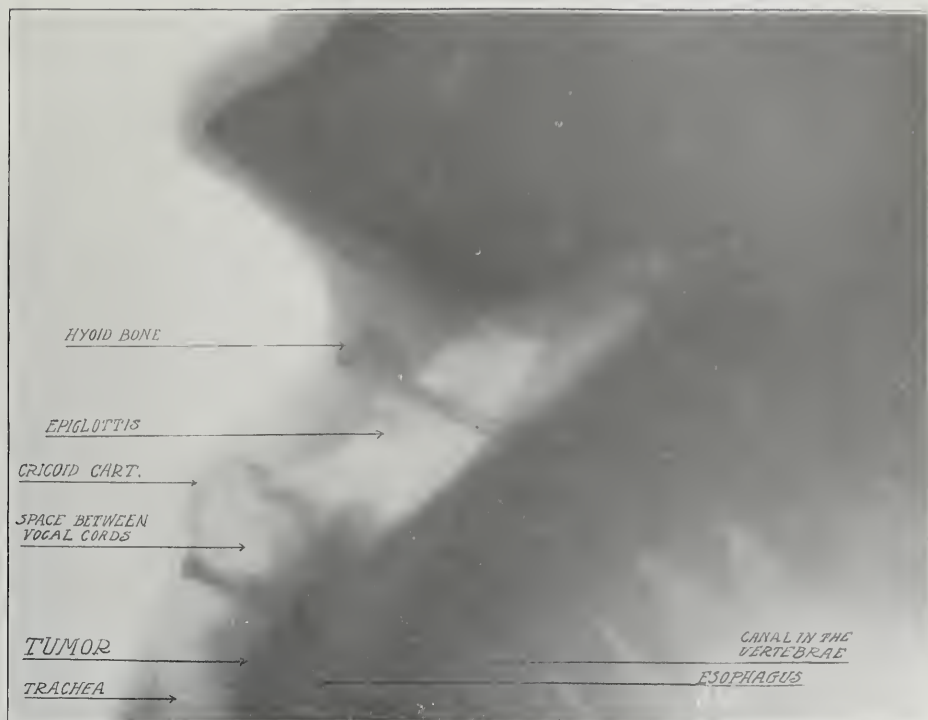
The Archives of Physiological Therapy — May, 1905



Stone in Bladder.

The same technique as employed with the preceding plates.

By Dr. W. C. Fuchs, Chicago, Illinois.



Tumor in the Trachea.

Skiagraphed with patient sitting on a chair, a five by seven plate laid against the trachea, head extended and bent a little toward one shoulder in order that the rays might traverse the plates between the vocal chords.

Fifteen-inch coil, electrolytic interrupter, tube of highest degree of vacuum located ten inches from plate, exposure one second. Metol-Hydrochinon developer.

It is usually taught that hard tubes are suitable only when penetration of dense structures is desired, and soft tubes for soft tissue differentiation. Kassabian finds that hard tubes are well adapted for soft tissue skiagraphy if the exposure be very short and the plate carefully developed.

By Dr. M. K. Kassabian, Philadelphia, Pennsylvania.



Coxa Vara of Left Femur, in a boy six years of age who was also suffering from tubercular disease of knee joint; skiagraphed four months after orthopedic apparatus had been applied.

Skiagraph shows the angle of the neck of the femur to be more obtuse on the left side. Left iliac bone is larger, left pubic bone smaller than on the normal side. Lumbar and sacral vertebræ are twisted. Muscles of hip and thigh very distinct, testicles and cord visible. There is a cast on the left knee, plainly indicated in the picture.

Skiagraphed in dorsal decubitus, tube in the median line, anode 18 inches from the plate, exposure $\frac{1}{2}$ minute. Both feet were bound together so that they formed a right angle with the axes of the legs.

By Dr. M. K. Kassabian, Philadelphia, Pennsylvania.



Compound fracture of humerus caused by having the arm wound up by the belting of a shafting. The attempt to secure union was unsuccessful with two operations but successful after the third.

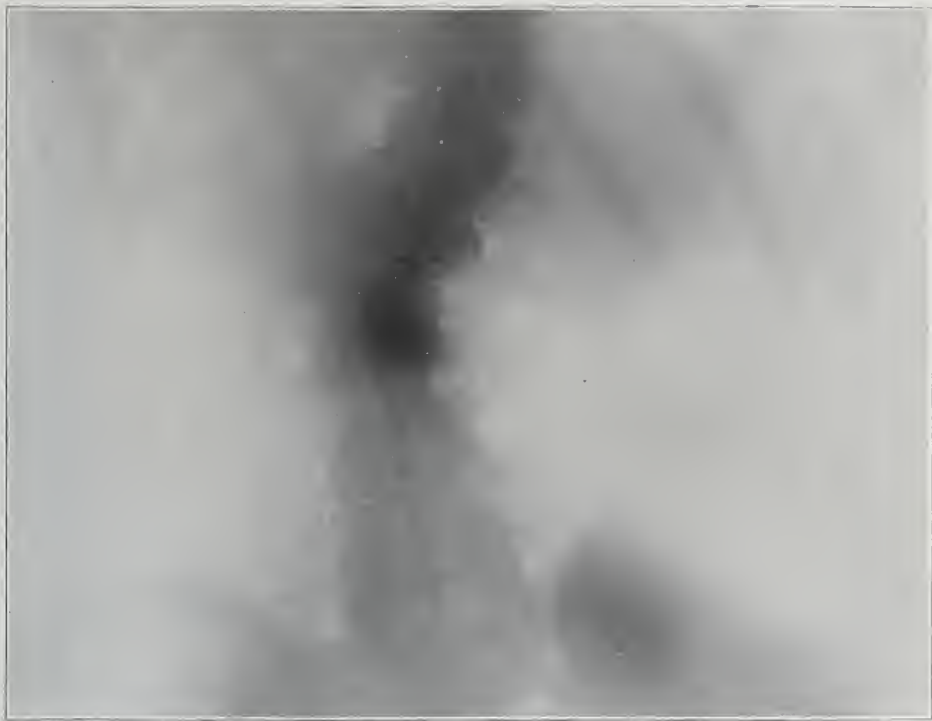
Skiagraphed with Mueller plain tube, five-inch spark gap; 40 seconds exposure; Forbes photographic plate without intensifying screen.

Skiagraphed in the Surgical Clinic of Prof. Roswell Park, Buffalo, N. Y., by Dr. Ward Plummer.



Compound fracture of radius and ulna; from same patient as Plate XXIII; injury sustained in the same accident at the same time. The lower end of the radius has united to the ulna, and the lower end of the ulna to the lower separated fragment of the radius; a very unusual condition.

Skiagraphed in the surgical Clinic of Prof. Roswell Park, Buffalo, N. Y., by Dr. Ward Plummer. Same technique employed as with Plate XXIII.



Broken back skiagraphed eight months after injury; successfully reduced by Professor Edds.

Exposure 40 seconds; anode 20 inches from plate; 30-inch coil; water-cooling tube; Hydrochinon developer.

By Dr. Gordon G. Burdick, Chicago, Illinois.



Figure I Pregnant Cat, Skiagraphed October 6, 1904



Figure II Pregnant Cat, Skiagraphed November 18, 1904

Illustrating The Effect of the X-Ray Upon Pregnancy — Tousey
The Archives of Physiological Therapy — May, 1905

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THE EFFECT OF THE X-RAY UPON PREGNANCY *

BY SINCLAIR TOUSEY, A.M., M.D., OF NEW YORK CITY

Surgeon to St. Bartholomew's Clinic.

THE purpose of this paper is to consider what effect, if any, the X-ray has in preventing conception or in producing abortion or still-birth.

In this connection there are to be borne in mind the valuable observations of Dr. F. Tilden Brown and Dr. Alfred T. Osgood (Archives of the Roentgen Ray, March, 1905) to the effect that all of the X-ray workers, 16 in number, whom they have examined have shown either complete azoöspERMIA or a degree of oligospermia or necrospermia, which depended upon the length of time during which they have been radiologists. He does not know whether this comes on gradually or "as a sudden climax after some particularly long and intense action of the rays." To what Drs.

Brown and Osgood say I may add that this condition develops in X-ray workers who have never experienced the slightest dermatitis or other visible effect from the X-ray.

Albers-Schoenberg's experiments on guinea-pigs and rabbits (Munich, Med. Wochenschrift No. 43, 1903) show that an exposure at a distance of five or ten inches for ten minutes a day for 35 days, produces azoöspERMIA without any visible injury to the animal.

Bergonie and Tribondeau (Archives D'Electricite Medicale, February 25, 1905), report that in experiments on white rats, complete azoöspERMIA with very marked atrophy of the testes and profound histological changes are produced by repeated exposures without any external irritation. Their applications were made with a tube of medium hardness, rays No. 6 Benoist, 10 amperes of primary current, and a distance of 15 centimeters between the anticathode and the testes, which was the only

* Read before the Section on Gynecology and Obstetrics of the New York Academy of Medicine, New York, April 27, 1905.

portion of the animal exposed. An application of 10 minutes represented 4 Holz knecht units. The exposures were about what would have been used in a case of cancer of the testes. The different rats were exposed to 5 applications of 2 H. every 8 days; 9 applications of 1 H. every 2 days; 11 applications of 2 H. every 2 days; 10 applications of 4 H. every 2 days; and 5 applications of 4 H. every 8 days.

Phillip (Fortschritte auf dem Gebiete der Roentgenstrahlen, December 9, 1904), reports two cases in which he X-rayed the testes for the express purpose of producing sterility. One of the patients was a man with consumption. The tube was at a distance of 10 or 15 centimeters and was of a low or medium vacuum. The exposures were 10 or 15 minutes every day for a month, making 365 minutes total exposure. The only external effect was a slight dermatitis of the scrotum, which healed in two weeks and left no scar. The semen was examined every eight days and showed absolutely no deviation from the normal during the entire 30 days of X-ray treatment. The patient then submitted to a ligation of both spermatic ducts. Six months later an aspirating needle plunged into the epididymis brought out testicular secretion containing no trace of spermatozoa.

Phillip's other patient was a man with pruritus ani, whose wife had long suffered from an affection of the throat and did not wish to have any more children. The technique was the same as in the first case; 195 minutes total exposure being given in 10 minute applications in the course of three weeks. Seven months later the semen was examined for the first time and complete azoöpermia was found. This effect was not accompanied by impotence.

The present author has for several years past been in the habit of enveloping the X-ray tube in an impervious shield (Friedlander's) which permits

the rays to emerge in only one direction. The operator and the patient are thus protected from this or any other undesired effect.

We come now to the effect of the X-ray upon the reproductive function of the female.

Halberstädter (Semaine Medicale, February 25, 1905), experimenting with rabbits exposed one-half of the abdomen to the X-ray for 30 minutes at each session. After ten daily treatments the Gräafian follicles were found very much diminished in number and of a degenerative appearance and after fifteen days of treatment the Gräafian follicles had entirely disappeared. But he thinks additional observations are required to determine whether the effect is a permanent one. Histologically, the ovary contained a great many round, sharply defined vacuoles without any endothelial lining and a homogeneous mass which became diffusely colored by eosine. There was no change in the corpora lutea. The primordial ovules were few in number and presented a degenerative appearance. He alludes to the observations of Tribondeau, Bergonie, and Recamier, who found that in rabbits exposed for from 16 to 140 minutes the weight of the ovary diminished by from 32 to 85 per cent. In all these cases the changes in the ovary took place without any change in the superficial tissues, skin, or hair.

Laquerriere and Labelle report (Bulletin Officiel de la Societe Francaise d'Electrotherapie, September, 1904), the case of a woman with an inoperable carcinoma of the neck of the uterus and the adjacent vaginal wall, invading Douglas's *cul de sac* and immobilizing the lower segment of the uterus. At the time that X-ray treatment was begun there was an enlargement of the body of the uterus which was supposed to be fibroid, but which turned out to have been due to pregnancy of two months advancement.

The treatment consisted at first in external applications of the X-ray over the abdomen, pubes, perineum, and loins. This was begun December 11th and continued to March 30th, the number of treatments given during this time being 39. The tube was placed at a distance of from 8 to 15 centimeters from the skin, spark-equivalent from 6 to 10 centimeters, anticathode reddening freely in from 15 to 20 seconds, duration of exposure from 2 to 8 minutes. From March 30th to June, 11 applications of the X-ray were made through a vaginal speculum as well as externally. The local and general conditions were so much improved that when her child was born, July 1st, the midwife who attended her did not notice that there had ever been any disease. The child was strong and well, but late in the autumn the mother's condition became worse again and an unfavorable termination was expected. The X-ray applications had been sufficiently vigorous at one time in February to cause an ulceration of the abdominal wall which took a whole month to heal. But this did not affect the vitality of the fœtus, which was then at its fourth month.

The observation of my own which I

wish to record was made in order to determine what effect, if any, would be produced by the short exposures which suffice for X-ray pictures. The subject radiographed was the cat belonging to our household. She is young and strong and has been the mother of several healthy families. The pictures were taken from the time that she appeared to be matrimonially inclined and this was five or six weeks before she showed any external evidence of pregnancy; they were taken at intervals up to the time when confinement was momentarily expected.

During the last ten days of gestation no radiograph was made. The cat was never in the X-ray room except during the taking of these pictures. Each picture was taken with the cat lying upon her left side on the photographic plate, held there by my own hands which rested upon the cat and were equally exposed to the rays. A twelve-inch Wappler induction coil was used; and usually a heavy anticathode Müller tube, No. 13; but for the picture of October 21st, a 40 centimeter Friedlander water-cooled tube was used. The exposures were designed to be of the same intensity and duration as for radiographing human

TABLE OF EXPOSURES.

1904.	Time of exposure.	Distance from Anticathode to nearest surface of animal.	Spark equivalent.	Radiometer readings (Tousey's).	Primary current.	Secondary current.	Primary winding.	Interrupter.
	Seconds.	Inches.	Inches.	Thicknesses of tin foil.	Amperes.	Milliamperes.	Self-induction.	
Oct. 6.....	10	15	3	5	10	3	Large	Wehnelt
Oct. 12.	15	14	2	5	11	2	Small	Caldwell
Oct. 16.....	50	14	3½	3	8	3	Large	"
Oct. 21.....	31	11	8	4	12	3	Large	"
Nov. 18.....	45	12	2	3	9	3	Large	"
Nov. 29.....	25	11	2½	4	10	3	Large	"
Nov. 29.....	40	11	2½	4	10	3	Large	"
Dec. 17.....	60	14	2½	7	9	3	Large	Wehnelt
Total.....	276 seconds, or 4½ minutes.

tissues of the same thickness, but owing to the cat's restlessness it was necessary to cut short some of the exposures. The same restlessness is partly responsible for any imperfections in the pictures. Measured by Holzkecht's chromoradiometer the total exposure of the nearest part of the cat's body would have amounted to only $\frac{1}{2}$ H., or $4\frac{1}{2}$ minutes for the whole series. One H., it will be remembered, is one-third of the amount required at a single exposure to produce a visible reaction upon the human face. The result, of course, was absolutely nil as far as the outward and visible appearance of the cat and as far as my own hands were concerned. The pictures were made on October 6th, 12th, 16th, and 21st, November 18th and 29th (at which date the cat first showed unmistakable external evidence of pregnancy), and December 17, 1904. Thirteen days after the last radiograph (that is, on December 30th, 1904), three large perfectly developed kittens were born dead.

The cat was not again exposed to the X-ray, and on March 12, 1905, two and one-half months after the still-birth,

four large healthy kittens were born alive. They are still well and strong and so is the mother cat.

It is unusual for kittens to be still-born and it had never happened before with this cat. I believe it to have been due to the action of the X-ray.

The conclusions to be drawn are as follows:

First. Precautions should always be taken to prevent unnecessary exposure of the ovaries or testes.

Second. Where X-ray exposure of the reproductive organs is required, as in the treatment of cancer, even the known existence of pregnancy may be disregarded, as even the full dosage required for a therapeutic effect does not necessarily interfere with the progress of gestation or the viability of the child.

Third. Even the small dosage required for radiography may sometimes destroy the life of the fœtus, but there is no reason to believe that such exposures, even if required on several different occasions, will produce even temporary sterility.

THE VALUE OF THE X-RAY IN THE TREATMENT OF TUBERCULOSIS

BY HENRY K. PANCOAST, M.D., OF PHILADELPHIA, PENNSYLVANIA

Lecturer on Skiagraphy and Assistant Instructor in Surgery, University of Pennsylvania, and Skiagrapher to the University Hospital.

THE treatment of tuberculosis has received so much careful study, and is founded upon such well worked out and common sense rules, that any statement claiming more for the X-ray in the deep-seated tubercular manifestations than that it is a useful addition to the therapeutic armamen-

tarium and the diagnostic methods of the physician and surgeon, would tend to bring discredit upon those who specialize in X-ray work. That it has valuable therapeutic properties in combating these lesions there can be no doubt. No deep-seated tubercular process can be aided by X-ray applications unless they are used in conjunction with the ac-

knowledge of rigorous rules of medicine, surgery, and hygiene.

The object of this article is to report briefly the work that is being done in the X-ray laboratory of the Hospital of the University of Pennsylvania in this direction, with special emphasis in regard to lesions of the respiratory system. It is as important, for reliable statistics, at least, to enumerate the failures as well as the successful results, and, moreover, in a field where successes are the exception and are far outnumbered by failures, each single cure should act as a stimulus to our best efforts toward a proper understanding of the use and application of this new therapeutic agent, especially when the older ones have not proven sufficiently satisfactory.

The value of the X-ray applications for tuberculosis of the superficial lymphatic glands requires but little comment, as this method is now recognized as a part of the medical and surgical treatment. It should not be expected to replace surgical procedures in any case where operation has heretofore been indicated. Its place lies in the treatment of the pre-operative stage of the condition, and as a post-operative measure to follow up the surgeon's work.

RESPIRATORY SYSTEM

Consideration will here be given to tubercular laryngitis, and secondarily to the pulmonary manifestation which is practically always present as the primary lesion. The following cases are cited:

Case 1. — J. K., white, male, 37 years, nativity and residence Philadelphia, occupation driver and motorman. Referred by Dr. W. B. G. Harland. Diagnosis, tubercular laryngitis and consolidation of the right apex with softening. No tubercular family history, except possibly in the father. Personal history negative except an attack of pleurisy in 1895, from which he fully recovered. In March, 1903, he began to

lose weight (138 to 121 pounds), and the diagnosis of phthisis was made in April, when his throat became sore, with occasional attacks of aphonia. In June, his weight was 122 pounds, had cough, tubercle bacilli in the sputum, hoarseness, dryness of the throat, occasional aphonia, flushing, night sweats, and a consolidation with softening at the right apex. Laryngoscopic examination showed an ulcer on the left side of the epiglottis, and a slight hyperemia of the cords.

When seen in September, he had gained 10 pounds, and the cough and night sweats had disappeared, but in October he contracted a severe cold, and became much worse. The laryngoscope then showed a perichondritis of the upper left part of the epiglottis, and some swelling of the commissure. During

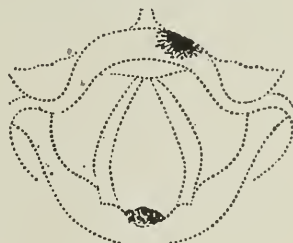


FIGURE 1

November, at the beginning of the "radium craze," 12 exposures of from 10 to 45 minutes each were made with a specimen of 18,000 activity radium bromide, with, of course, no result. When the patient was referred to me February 8, 1904, for X-ray treatment, the ulceration was still present on the epiglottis, and the swelling of the commissure had become a well-defined tuberculoma. (Fig. 1.)

Five minute exposures were made to the neck, each side alternately, and to the upper portion of the thorax. At the end of three weeks, the inflamed area of the epiglottis had decreased, but the tuberculoma was larger and the throat felt

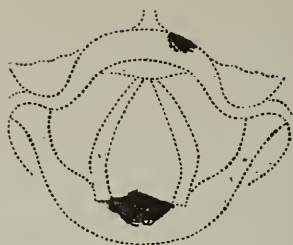


FIGURE 2

worse. (Fig. 2.) Treatment was stopped for one week and then resumed, and after eight more weeks of treatment, Dr. Harland reported that the ulceration had almost healed, the tuberculoma was pale and shrunken, and all signs of inflammation had disappeared. (Fig. 3.) The lung condition was then about the same as at the first examination, and his weight varied from 126 to 132 pounds.

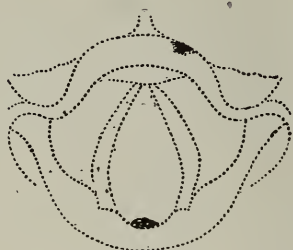


FIGURE 3

Exposures were continued less often until September, 69 having been made during a period of 32 weeks. The average length of each was from 5 to 8 minutes. A medium vacuum tube was used, having a resistance of about 3 inches of spark gap, and the anode was placed 12 inches from the patient. There was always a decided skin reaction present.

The patient was examined in January, 1905, by Dr. W. B. Stanton, and he reported that the old lesion at the apex could scarcely be located. Dr. Harland reports the larynx cured, and states that

the patient works regularly, seems to be in perfect health, and weighs 135 pounds—a gain of 13 pounds.

Case 2.—W. D. A., white, male, 36 years, born Washington, D. C., residence Philadelphia, single, occupation broker. Referred by Dr. Allburger for X-ray or Finsen light treatment of an advanced tubercular laryngitis complicating a pulmonary lesion of each apex, with a small cavity in the right apex. No tubercular family history. His throat had become worse during a period of “open air” treatment in connection with a sanatorium, and the severe cold of the zero weather had placed his larynx in a condition such that every effort at swallowing was agonizing. Evidently life would be short unless the patient could be relieved sufficiently to take nourishment.

In January, 1905, Dr. Fetterolf examined his throat, and treated him. Both arytenoids were then reported to be badly infiltrated and swollen, and the left cord more or less fixed in semi-abduction. (Fig. 4.) Treatment was be-

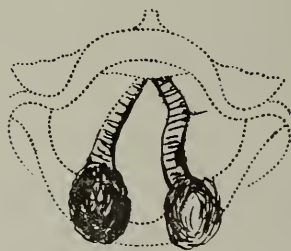


FIGURE 4

gun February 19th. Largely as an experimental measure, daily ten minute exposures by a Finsen-Reyn lamp were made to each side of the neck alternately, over the larynx, during the whole course of treatment. If of no greater value, these applications certainly tended to control a skin reaction due to the X-rays. At this time the patient's weight was 101 pounds.



Figure 7

Tubercular arthritis of right knee, child three years old. Lateral view, plate under outer side of limb. The picture shows an epiphysitis of the lower femoral epiphysis, enlargement of the condyles, with rarefaction, excessive or premature ossification of the patella, with rarefaction and distention of the joint capsule under the ligamentum patellae.

Macalaster and Wiggin's tube, 24-inch coil, electrolytic interrupter, current 4 milliamperes in secondary, tube resistance 3-inch spark, exposure 15 seconds, Cramer X-ray plate 12 inches from anode, metol developer.



Figure 8

Normal left knee of the same patient, taken under the same conditions.

After one week of daily Roentgen exposures to each side of the neck alternately and to the upper part of the thorax he had gained four pounds, felt better and stronger, his throat was not nearly so sore, and swallowing was much easier, and he was able to sleep well at night. After ten days, his throat became worse, and the X-ray was discontinued for a short time, but soon resumed on alternate days, with five-minute exposures instead of ten. After two weeks, two tuberculomata were seen on the right cord (Fig. 5) nearly ready to ulcerate,



FIGURE 5

and dysphagia was intense. Relief followed in a few days, however, and swallowing without much discomfort continued until he left the hospital, April 20th. The tuberculomata had then disappeared, the cords were less swollen, and the left one was more movable. (Fig. 6.) His lung condition had certainly not progressed, the cough was better, and the only really unfavorable sign was a continued gradual loss of weight after the first gain.

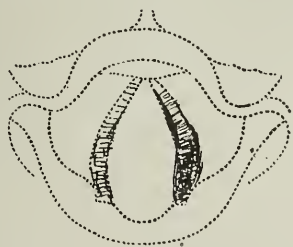


FIGURE 6

Case 3. — E. N., white, female, 34 years, married. Referred by Dr. Stout. Diagnosis, tubercular laryngitis with pulmonary lesion of the right apex. She had lost 15 pounds in three months, could swallow liquids only, and spoke in a whisper. Laryngeal examination showed swelling and hyperemia of both cords. X-ray treatment was begun February 13, 1905, by Dr. Stout and myself, and at the present date, after 31 applications during a period of 11 weeks to the neck and thorax (through the clothing) she can swallow anything without discomfort, has but an occasional dryness of the throat, coughs less, has gained 9 pounds, and looks and feels much better and stronger. The exposures were of 10 minutes each from a hard tube of 3 to 5 inches spark resistance, with the anode 12 inches from the body. The current in the secondary was 2 to 3 milliamperes. Improvement was first noted after the fifth treatment and progressed until the fifteenth, when an over-reaction required a reduction in dosage. After this the improvement continued.

Case 4. — A. G., white, female, 22 years, single, dressmaker. Referred by nose and throat dispensary. Diagnosis, tubercular laryngitis with left sided pulmonary lesion. Tubercular family history. The laryngoscope revealed a tuberculoma of the interarytenoid space. She has had 10 applications in three weeks. The usual improvement noted after the first few treatments was followed by a reaction and the appearance of a small ulcer near the tuberculoma. A decrease in dosage has been followed by marked improvement and the ulcer is healing and the swelling subsiding.

The following conclusions are drawn from these cases:

1. Tubercular laryngitis responds most favorably to X-ray treatments, and may often be cured. Recurrence is guaranteed only by a subsidence of the activity of the primary pulmonary lesion.

2. Great care is necessary in determining the appropriate dosage in each case, as too vigorous treatment will produce a reaction that may be unfavorable.

3. The pulmonary lesions may be benefited often, provided a mixed infection has not taken place, but even greater precaution should be observed.

4. Finsen light applications are probably valueless except as prophylactic measures against X-ray dermatitis. At any rate, only the most powerful lamps need be tried.

Here and elsewhere I have very little confidence in the value of radium or radio-active substances as therapeutic agents. I do not see sufficient grounds for believing that radium will do anything that the X-ray will *not* do, and it will certainly accomplish very little in comparison with the gratifying results brought about by the X-ray.

TUBERCULAR PERITONITIS

We have treated two cases of tuberculosis of the peritoneum following exploratory laparotomies. The first case was referred to me by Dr. Shober for X-ray treatment during his absence from the city. He had successfully dealt with two or three recurrences, and sent the patient to me at the beginning of another. Thirteen exposures during a period of 11 weeks made an apparent cure, and Dr. Shober reports that she has had no further trouble since I last saw her, over six months ago. The second case is now under treatment, and though improving, there is nothing worthy of mention as yet.

We must realize that it is presumptuous to claim much credit for the X-ray in treating a case of this kind after an exploratory laparotomy, as the frequency of cures brought about in some manner by opening the peritoneal cavity is so well recognized.

JOINTS

The value of X-ray applications in

joint lesions must at present be held *sub judice*. They can certainly not do good unless, in conjunction, the usual and recognized surgical methods of treatment are rigorously carried out. Several cases have been or are still under our care, but the results have so far not been noteworthy. The accompanying skiagraphs (Figs. 7 and 8) represent the diseased right knee and normal left knee of a child now under treatment. While in the hospital under close observation, there was some improvement, clinically, but the share of credit due to the X-rays cannot be determined. The knee became worse when the patient was taken home and allowed to walk and was surrounded by improper hygienic conditions, but improvement is now again manifest. A recent skiagraph shows no decided change.

Similar remarks are applicable in connection with our experiments in treating spinal tuberculosis. It would seem that the most practical expectations in such cases would be the possible absorption of an exudate in a pachymeningitis when such a condition is present.

SUPERFICIAL LESIONS

Space forbids a discussion of these manifestations, and literature abounds with them already. The doubt still remains as to the relative values of the X-ray and the Finsen light. In my mind, one is of no more value than the other, as each has its own special indications. Proper judgment is the guide. In most instances I have found that a combination of the two methods gives the best results.

The accompanying photographs (Figs. 9 and 10) represent an obstinate case of lupus of the face and nose that has been treated since February 15, 1903, and up to the present time has received 223 X-ray exposures and 15 Finsen light applications. Unfortunately we have no photograph of his condition



Figure 9



Figure 10

CUT REVERSED



Figure I

Normal chest of healthy young man. Bronchial glands on each side conspicuous. Note the rounded distinct outline of the heart.

when he first came under our care, but the nose was covered with ulcers, there were nodules and ulcers covering both sides of the face in front, and a marked degree of ectropion of the lids on both sides.

The X-ray was successful in removing almost all of the lesions and in causing absorption of exudate, but wherever there has been a marked skin reaction produced, such as we have had to produce in this obstinate case, the pigment layer has been destroyed, and this seems to be a permanent loss so far. This has been our experience without exception, when applying the X-ray to the negro. The patient has been very careless about

his attendance during the past few months, and new lesions are continually making their appearance.

On account of the undesirable X-ray skin effects in this case, we have lately used the Finsen-Reyn lamp, and when attendance is regular, the results are preferable to those derived from the X-ray. Freezing with ethyl chloride spray has also been of great assistance in dealing with the larger lesions. Fig. 9 represents the appearance nearly two years ago, and soon afterwards the patient was much better. Fig. 10 is made from a recent photograph, shows that there has been a partial recurrence, and that there has been no return of skin pigment.

THE INTERPRETATION OF RADIOGRAPHS OF THE CHEST*

BY P. M. HICKEY, M.D., OF DETROIT, MICHIGAN

IN bringing the above topic to the attention of this Society, it is the purpose of the writer to present the subject so as to give rise to discussion rather than to formulate certain set rules.

While the technique of rapid radiography of the chest has made great progress, particularly during the last three or four years, it is advisable for us, now that we are able to produce pictures of the chest of considerable clearness, to consider well the value of these representations in the art of diagnosis. Radiography has taken a prominent place in internal medicine and it is the belief of those who have paid attention to this particular branch that its usefulness will be increased constantly.

In the technique of the production of chest negatives, the aim is to make the exposure as rapidly as possible and at the same time to secure the greatest

amount of contrast. The realization of these two points is accomplished by many radiographers with some variations in technique. The essentials of this technique can, perhaps, be briefly summarized. First, a mastery of the tube, so that the vacuum is suitable for the individual case; second, the employment of a secondary current which will best suit the vacuum selected; and, third, the development of the plate by reducers which will secure the greatest detail and the maximum contrast.

In the interpretation of chest negatives, it is important to know the position of the target of the tube with reference to the area exposed. If the exposure is made with the plate against the anterior surface of the chest, the position of the target will perhaps best correspond to a perpendicular erected from the center of a circle, which would embrace the thoracic area. If the exposure is made, as it now generally is, sufficiently short so that the breath is held and respiratory movement minimized, the detail will, of course, be greatly increased.

* Read at the Fifth Annual Meeting of the American Roentgen Ray Society at St. Louis, Mo., Sept. 9-13, 1904.

In the interpretation of chest negatives it is, of course, best to use a suitable means of illumination of the negative, secured usually by a proper illuminating box. If extraneous light is excluded and the observer is seated at some little distance, say eight or ten feet from the negative, the general effect will be much better, and the appearance will also more nearly approach that of the stereoscopic image. In an exposure made with the front of the chest wall next to the plate, with the target behind the patient, and the arms elevated so as to remove the shadows of the scapula from the pulmonary area, the crossing effect of the shadows of the anterior and posterior portions of the ribs tend to heighten the stereoscopic deception.

In considering the different objects presented, we note first the line of the diaphragm. This is usually higher on the right side than on the left in the normal chest. This difference often amounts to from one-half to two inches. In cases of effusion or great thickening of the pleura, the diaphragm line will be lost on the affected side. In emphysema there will often be seen a somewhat triangular appearance, differing from the usual dome with its symmetrical curves.

In the skiagraph of the cadaver, where pulmonary tuberculosis was the cause of death and the abdominal contents have fallen away from the diaphragm, the shadow of the diaphragm can be seen distinct from that of the liver.

The next point which will engage our attention is the distance of the ribs one from the other. In the time exposures which were formerly made the shadows of the ribs appeared much narrower, because the central part only of the moving rib affected the plate during the exposure. In cases of restricted respiratory movement on one side we will find the ribs closer together. This is well illustrated by a plate showing a tuberculosis of one side, in which there is a marked difference in the position of the ribs of

the right and left side.

In noting the cardiac shadow, we find if the target is placed somewhat low, say on a line with the apex of the heart, that we will get a clearer differentiation of the cardiac shadow from the line of the diaphragm; the size and the position of the cardiac shadow are somewhat dependent on the position of the target. It is evident that if the target is placed opposite the center of the chest, the consequent distortion will render the apex of the heart more prominent, and vice-versa.

In studying the shadows cast by the aorta upon a fluoroscopic screen, we often meet with cases where it is difficult to accurately differentiate between what might be termed a physiologic condition where the aorta appears large and cases of beginning aneurism. Of course in well defined or advanced cases of aneurism this difficulty of differentiation does not exist. Owing to the constant pulsation of the aorta during exposure, even when the time is limited to one or two seconds, we find difficulty in stating the size of the aorta accurately.

In the negative of a normal chest we find numerous fine white lines ramifying from the sides of the sternum at about the level of the third rib. The interpretation of these lines, which seem more prominent on the right than on the left side, has been very interesting to the writer. For a time it was thought that they represented beginning areas of consolidation; they have been interpreted as the shadows of the walls of the ramifying bronchi. An English writer has considered them to be the lines of the interlobular pleura. For the sake of establishing the meaning of these tracings, a number of experiments were made. A cadaver was chosen, which was injected with the ordinary lead solution of the anatomical laboratory, as fully as possible, the solution being injected at different intervals, so as to distend thoroughly the vessels. The cadaver was allowed



Figure II

Advanced tuberculosis limited to upper right. The compensatory increase in the distance between the ribs is well shown.



Figure III

Skiagraph of cadaver. Trachea and bronchi filled with fine shot; blood vessels injected with bismuth and glycerine solution. Note relations between bronchi and blood vessels, the latter being recognizable as wavy lines.

to dry out, so that the tissues did not contain much fluid. An exposure was then made with the plate next to the dorsal side of the thorax, under conditions such as would accentuate the contrast of the injected vessels. On comparing this plate with the normal chest of the young adult, it will be seen that there is a marked similarity between the vague tracings of the living subject and the representations of the pulmonary vessels of the cadaver.

In order to demonstrate the relations of the vascular and respiratory vessels, lungs were secured from an autopsy on a man who died from an accident; the trachea and bronchi were removed and filled with very fine shot, which were forced into the various ramifications as far as possible. An exposure was then made; the course of the bronchi can be seen from the plate. The blood vessels from the same pair of lungs were then injected with a bismuth and glycerine solution, the shot being still in situ, and a skiagraph made, which displays the relation of the injected blood vessels to the bronchi filled with shot—the bronchi, of course, being easily recognized by the wavy lines. A study of these two plates shows the vessels more prominent than the bronchi.

In order to further elucidate this subject, a medium-sized dog was secured, which was killed by chloroform, and the chest radiographed immediately after respiration had ceased. This secured a natural injection of the blood vessels. In studying this plate we find the line of the trachea and the ramifications of the bronchi showing as darkened streaks between the grayish shadows cast by the cartilaginous walls. In order to further investigate the difference between the shadows cast by the blood vessels while filled with blood and the bronchi, the aorta, the trachea, and one lobe of the lung were removed. These were placed side by side on a plate and radiographed. The aorta filled with blood showed much

greater obstruction to the Ray than did the walls of the bronchi. In a skiagraph of the normal human neck in a lateral position the air passages naturally appear as darkened streaks in contrast with the adjacent soft parts.

From these experiments it would seem to the writer that the tracings which we often see in the midst of the pulmonary tissue *usually* represent the ramifications of the pulmonary vessels. If we are able to shorten our exposures so that the impression can be made on the photographic plate so rapidly that the movement of the pulmonary vessels during cardiac action is minimized—in other words, if we make our exposure so fast that we get rid of the pulsation—we believe that much more detail would be secured.

It is important in studying chest negatives to have a standard of translucency. Generally the triangular space at the lower and outer border on each side is not obscured, except in cases of effusion. This region rarely shows tubercular deposits. For this reason we may adopt this triangular space as a unit or standard; in so doing we can secure a means of comparison of other parts of the chest. Such a standard, although not invariably correct, is indeed helpful. Where we have a thickening of the pleura, such as results after a healed pleuritis, or an obstruction to the ray caused by the presence of fluid, we must adopt another standard. The diagnosis of fluid in the chest is usually made with great ease, the lesion being most often unilateral, so that we have a fair means of comparison of one side with its fellow. In collapse of the lung following resection or perforation, the extent of the space between the pulmonary and parietal pleurae can be easily measured.

Tubercles in the lungs show themselves in the radiograph as small white dots of varying size and shape, but which are usually sufficiently characteristic to be at once recognized by any one who

has had experience with their appearance. They may at first sight be confounded with the tracings left by the blood vessels, but a little care and discrimination will easily suffice to differentiate without any probability of doubt.

Tubercular pneumonia will, of course, cause a diffuse obstruction to the ray with consequent easy recognition of the area affected, though not of the nature of the infection. Cavities if filled with air will be easily differentiated. Care should be taken not to consider as excavations the rounded dark areas in the apices formed by the normal pulmonary shadow within the natural curves of the first set of ribs. The latter are regular and symmetrical, and thereby not to be confounded with vomicae. Tubercular glands, especially if they have been the seat of a calcareous change, show very plainly. Experimental work, however, should be done with the lungs which have been the seat of tuberculosis, in order to study the variations in the records left by isolated tubercles in the pulmonary tissue and by tubercular glands along the course of the bronchi. Tubercular glands in the neck which have been the seat of chronic change, producing deposits of lime, can, of course, be very easily detected. This point has been well brought out by Carl Beck in his recent work.

In studying chest negatives it is impor-

tant to remember that the mammary glands in females cause a decided shadow. This fact, unless recognized, might easily lead to incorrect conclusions about the translucency of the pulmonary tissues. The pectoral muscles, while usually visible, do not often cause confusion.

In closing this short essay the writer would like to make prominent the following points:

First, that the marked improvement in radiographic technique has resulted in adding a diagnostic measure of great value to our armamentarium of already tried methods of thoracic exploration.

Second, to realize to the fullest extent the benefit which can be obtained from this new diagnostic aid, the observer should be experienced in the reading of these negatives.

Third, the shadows which emanate from the roots of the lungs in the normal chest are distinctly those of the larger pulmonary blood vessels.

Fourth, that the triangular space found at the lower and outer border of the chest usually furnishes us a standard of translucency.

Fifth, that this means of thoracic exploration, while already developed enough so as to be of considerable diagnostic value, is destined through future study and experiment to yield conclusions which will be still more valuable.

NOTES ON X-LIGHT

BY WILLIAM ROLLINS, M.D., OF BOSTON, MASSACHUSETTS

THE TREATMENT OF INTERNAL DISEASES BY X-LIGHT

THE chief use of X-light in therapeutics is in treating diseases below the surface. For surface conditions derma rays are more suitable, because they do not so profoundly affect the vital processes and require less

expensive apparatus. In a number of papers published some years ago X-light was proved capable of producing blindness, paralysis, death of the fœtus or of the animal, without burning the skin, provided certain precautions were taken. To show these results were not the effect

of any other agent, the animals were enclosed in a Faraday chamber, hung within another Faraday chamber. The experiments were the first which by excluding the participation of all other causes clearly showed what a dangerous agent X-light was and that the only symptom previously supposed to be produced by it—burning of the skin—was one of the minor effects. These experiments were undertaken to see if X-light could act below the surface, and if so whether the effects could be obtained without risk to the superficial tissues, for I had a friend who had been operated on for cancer in such a position that a second operation would not have been possible. As a result of the experiments X-light was recommended for treating internal diseases and certain principles which must always be used were stated. They were somewhat as follows:

The source of radiation must be in a box from which no radiation can escape except the smallest beam that will cover the area to be treated.

The source of radiation should be placed at a long distance from the patient, that the intensity of the radiation on the skin may not be measurably greater than at the deeper lying diseased tissues.

The vacuum tube should be arranged to give a radiation not easily absorbed by the skin to avoid ionic destruction of the superficial tissues before therapeutic effects are produced on the deeper tissues.

Selective filters must be used to strain out those accompanying radiations which are easily absorbed by the skin.

A patient must be enveloped in a non-radiable covering, exposing only the necessary area.

Instead of burdening this note with details the following passage is quoted from an essay by Carl Hilty: 'The reading of original sources gives one the advantage of being sure of his material and of having his own judgment about it. There is this further advantage, that the

original sources are in most cases not only much briefer, but much more interesting and much easier to remember than books that have been written about them. One of the great mistakes of modern scholarship as distinguished from that of the classic world is—as Winkelmann has pointed out—that our learning in so many cases consists in knowing what other people have known.'

March 31, 1905.

DESCRIPTION OF THE FIGURES

In Fig. I is shown a non-radiable tube box with a non-radiable cone lined with fluorescent material—to limit the beam of X-light; the end of the cone being covered with a selective filter to strain out not only those primary radiations easily absorbed by the superficial tissues, but also those secondary ones resulting from the impact of the primary rays. The top of the box has a non-radiable window of lead glass (SS). By looking in the mirror (M), which can be attached either to the top or bottom of the tube-box, the tube can be seen. The position of the tube vertically is controlled by the handle (H) operating the rack (R), and in a horizontal plane by the handle (HH). For an explanation of the other parts of the tube-stand refer to Note 156, *Electrical Review*, June 6, 1903.

Longer cones than that shown in Fig. I are too heavy for attachment to the regular diagnostic tube box, therefore in Fig. II is shown a tube box and stand especially for therapeutic work. This arrangement is much simpler and cheaper to construct than the necessarily complicated tube stand required for use in diagnosis.

The box holding the tube is also the limiting case for the beam of X-light. The tube is contained in one end of the case, shown at T, and is separated from the limiting part of the case by a dia-

phragm plate only large enough to allow a small beam of X-light to escape. The case is lined throughout with a non-radiable coating, and is provided with windows in the top and bottom glazed with non-radiable lead glass, which prevents the escape of X-light and allows the tube to be seen either directly or by reflection in the mirrors M.

The tube case is supported on an adjustable stand. The end opposite the tube is closed by a selective filter (SF) which strains out the radiations in the

direct and reflected beams that are not wanted. Over the end of the selective filter is a diaphragm plate which limits the size of the escaping beam after it has been filtered. When these long limiting attachments are not used and the size of the beam of light is determined only by a diaphragm attached to the tube box, the selective filter should be in contact with the patient, covering the opening in the non-radiable cloth in which he is enveloped.

ESCULINIZING X-LIGHT APPARATUS

Dr. William James Morton has stated that "test tubes in which fluorescent solutions of esculin were allowed to stand during one or two weeks were found themselves to have become in-

tensely fluorescent after being emptied and carefully washed and dried."

"Such a test tube casts a shadow on a screen or gives a photographic print as dark as ordinarily would be caused by

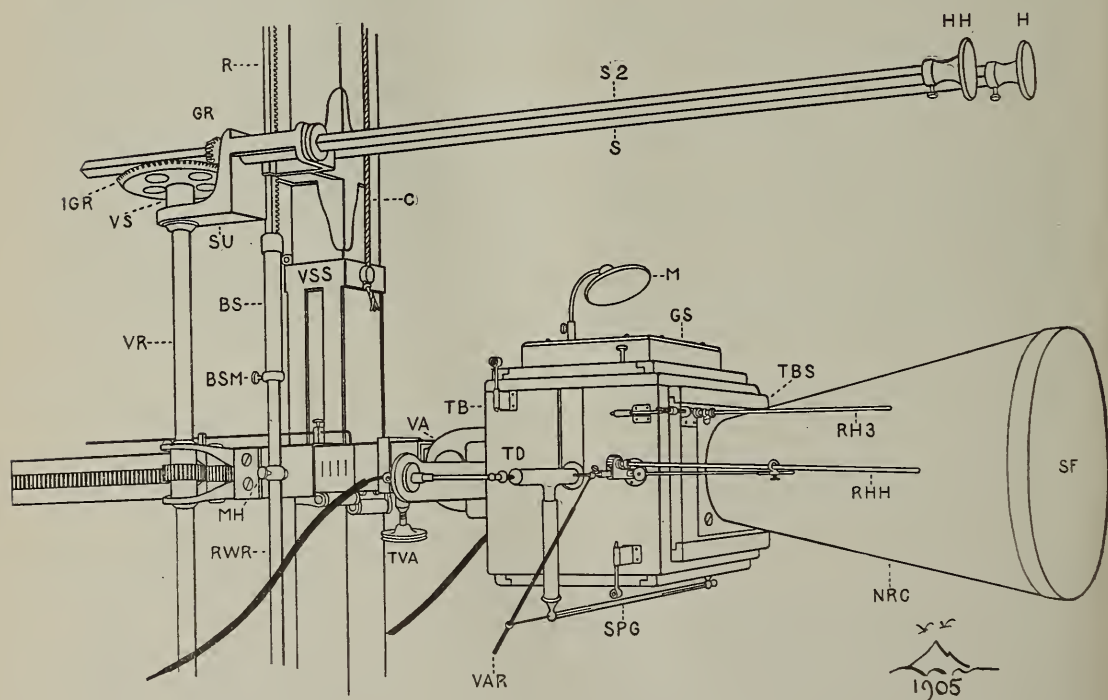


FIGURE I

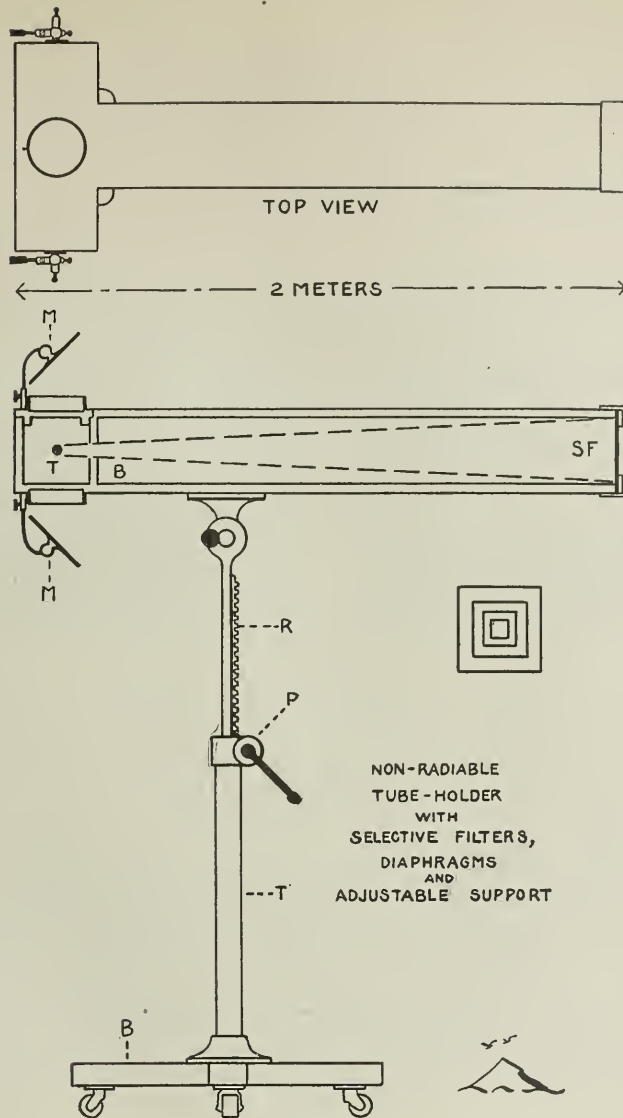


FIGURE II

a piece of lead one-quarter of an inch in thickness."

The following are some of the practical applications of this discovery:

In former Notes it was shown that X-light profoundly affected the vital processes, and therefore an X-light tube should always be used in a non-radiable case from which no X-light can escape

except the smallest beam that will cover the area to be examined, treated, or photographed. Such tube cases were illustrated in Note 36, *Electrical Review*, August 17, 1898, and in Notes 47, 94, 112, 116B, 116C, 139, 140, 143, 149, 155, 156, 162, 168, 169, 179D, 186, 199. The simplest way found to make the tube case non-radiable

was to coat it with a lead paint and to cover this with a fluorescent varnish. To allow the X-light tube to be seen, windows of lead glass were provided. These windows are heavy. As it is desirable to save weight the windows could be made thinner, non-radiability being obtained by soaking the glass in esculin solution.

In 1897 attempts were made to prevent X-light from escaping from the X-light tube, except in the required beam, by making most of the tube of lead glass. This was not practical. The result sought—non-radiability—should be obtained by soaking the tube in an esculin solution after first coating a small area opposite the target with asphaltum varnish. When the tube is taken out of the esculin solution and the varnish removed we should have a non-radiable tube with a small radiable window for the escape of the required beam of X-light.

In Note B, *International Dental Journal*, July, 1896, a non-radiable cryptoscope—fluoroscope—was shown, in which the observer's eye was protected

from the X-light by an eyepiece of lead glass. In Note 145, *Electrical Review*, March 14, 1903, other forms of non-radiable cryptoscopes were illustrated. With the powerful apparatus now to be obtained such cryptoscopes require to be very heavy. Weight should be saved by treating the glass eyepiece with esculin solution and by making the walls of wood and coating them with a paint made of Morton's esculate of silica. A simple form would be an esculated water glass.

In Notes 45A, *Electrical Review*, February 8, 1898, and Notes 94, 116C, 179I, it was shown that a patient should be protected with a non-radiable covering having an opening only large enough to allow X-light to reach the desired area. Such coverings, when made non-radiable by paints of dense metals, are heavy. They could be made lighter by using a paint made of Morton's esculate of silica.

There are many other uses which can be made of Morton's discovery; a few only are mentioned to call attention to the matter.

A PORTABLE ILLUMINATION BOX

BY G. E. PFAHLER, M.D., OF PHILADELPHIA, PENNSYLVANIA

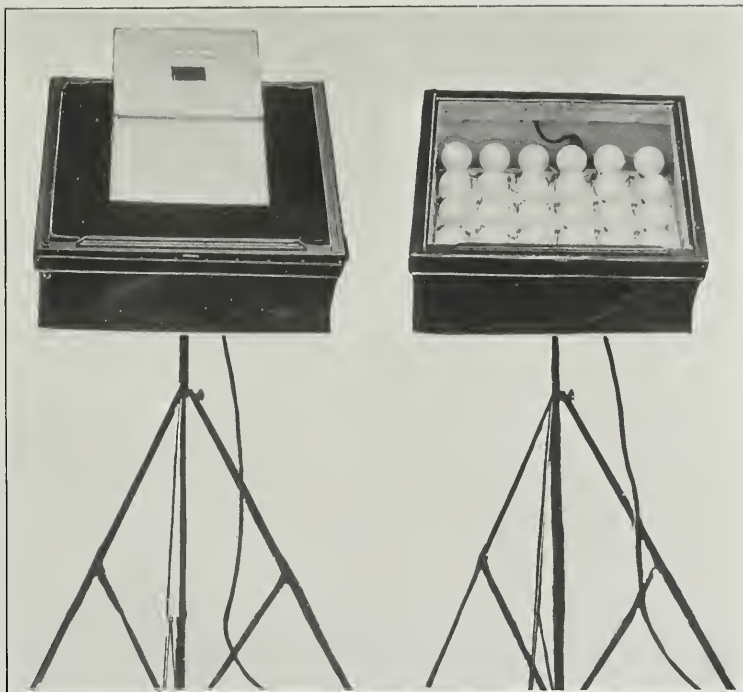
Director of the X-Ray Laboratory, Assistant Physician to the Medico-Chirurgical Hospital, Lecturer upon Medical Terminology and Symptomatology, and Demonstrator of Physical Diagnosis in the Medico-Chirurgical College.

THE need of an illumination box for the purpose of demonstrating and studying X-ray negatives has long been felt. By this means whole classes or societies are enabled to follow the demonstrator as he points out the various normal and pathological structures. Words need not be wasted in producing arguments to show

the advantages of such an apparatus. A number of apparatuses for this purpose have been devised.

The apparatus which I shall describe has served us well in the Medico-Chirurgical Hospital during the past two years, has been shown to the Philadelphia County Medical Society, and I believe has certain advantages over the others.

The illustrations, I believe, are suffi-



Dr. G. E. Pfahler's illuminating box for the study of X-Ray negatives. Left hand figure shows external appearance, right hand figure shows interior.

ciently explanatory, but I will give a brief description. The base or stand consists of a heavy folding music stand. The box itself consists of a frame, the inside measurements of which are 14 x 17 x 10 inches. This frame is supported by two bands of iron which cross and curve upward on each side, to be fastened to the top of the frame.

At the point of intersection of the cross bands of iron, the box is fastened by a thumb screw to the top of a rod which has been flattened and curved at an angle of 45 degrees. This rod fits into the music stand.

The lighting arrangement itself consists of a bank of thirty 8-c. p. frosted lamps. This gives a beautiful uniform light. I at first used four 32-c. p. lamps,

but found that they gave an uneven light which was objectionable. The present arrangement is more expensive, but well worth the difference in cost.

The top of this box is covered with ground glass and this in turn with a cardboard mat, cut to fit the various sizes of plate smaller than 14 x 17.

The whole box is now covered with black felt, which confines the light. A row of holes are punched around the top and bottom for the purpose of ventilation.

At first I used a rheostat to control the current, but lately have discarded it, believing that it is not necessary. The box gives a beautiful uniform light, and when the stand is folded the whole apparatus can be carried in one hand.

EDITORIAL

WILHELM KONRAD ROENTGEN

WILHELM KONRAD ROENTGEN, physicist, in whose honor a Congress of Radiological Science was held at Berlin, Germany, from April 30 to May 3, 1905, and this issue of *THE ARCHIVES OF PHYSIOLOGICAL THERAPY* is made a special Roentgen number, was born at Lennep, Germany, March 27, 1845. He finished his education under Kundt in Zurich, graduating from there in 1869. He went to Würzburg in 1870 as the assistant of Kundt. In 1872 he went to Strasburg, and settled there permanently in 1874. After a short stay as professor at the academy at Hohenheim, he became Extraordinary Professor in Strasburg in 1876, and Ordinary Professor of physics in Giessen in 1879. In 1888 he took up a similar position in Würzburg.

His experimental works, published in the "Annalen der Physik und Chemie," treat of the accurate calculation of the relationship of the specific heats for air; the changing of volume and the double-breaking of di-electric bodies through the action of electric currents; the electro-dynamic action of such bodies during their passage through a homogeneous electric field; and the compressibility of liquids and the effect of pressure upon various of their physical properties.

The name of Roentgen did not become widely known, however, until the beginning of 1896, when his discovery of the X-rays (as he called them, but which have since been named the Roentgen rays) placed him at once among the best known scientists of the world.

Little need be said to the readers of this journal about the inestimable assistance which his discovery has given in the solution of problems in the field of diagnosis, or the immense power into which it has developed in the field of therapeutics. It was not only a great discovery as regards pure science, but it carried with it the unusual property (as far as purely scientific advances are usually concerned) of being immediately, directly, and inherently, a boon of unspeakable value from a humanitarian standpoint. It ranks, in the way of practical importance, on a level with the discoveries of anæsthesia and antiseptis, and has shed upon the name of Roentgen a luster as unique as it is brilliant and enduring.

Professor Roentgen is a large man (six feet tall and well-proportioned), has abundant brown hair and a large, full beard. He speaks slowly and quietly in a deep, bass voice, and his conversation is permeated by a fascinating, dry humor. He is very modest in his ways, and refers to his discovery as something that "can be used well sometimes." Unlike the majority of those who have discovered and promulgated new and great truths of importance in the medical world, he has lived to see the acceptance and appreciation of his work, and we wish him long life and good health, in which to enjoy the well-merited honors which should accrue to one who has rendered a service of incalculable value to humanity at large, and which marks the beginning of a new epoch in our conceptions of physical forces and laws.

AMERICAN ROENTGEN RAY SOCIETY

The next (sixth) annual meeting of the American Roentgen Ray Society will be held at the Johns Hopkins University, Baltimore, Md., September 28, 29, and 30, 1905.

Arrangements have been made for an excellent program, and a large attendance is expected. The papers of the meeting for the first day will deal with the X-ray in diagnosis, and those of the second and third days

with its therapeutical uses. There will also be an evening exhibit of lantern slides which promises to be extremely interesting.

The Belvedere Hotel has been selected as headquarters.

X-RAYS AND STERILITY

The discovery that sexual sterility not infrequently follows prolonged or frequently repeated exposures to X-rays is a subject of vast moment, and merits the immediate and earnest consideration of workers in this line. We shall not write an editorial upon the subject, because all that is known about it will be found in the abstracts of articles dealing with this matter, on pages 124, 149 and 199 of the April and May issues of *THE ARCHIVES*, to which is called the attention of those desiring to know more of the observations available to date.

ADDITIONAL DEPARTMENTS

It is intended that *THE ARCHIVES* shall cover the whole field of physiological therapy in fact as well as in name, and the initial, formal introduction of departments of Hydrotherapy, Mechanotherapy including physical exercise, Psychotherapy, Dietotherapy, and Climatotherapy, will take place in this and the next (June) issues. These departments will be under the charge, respectively, of Drs. John Harvey Kellogg of Battle Creek, Mich.; Jay Webber Seaver of New Haven, Conn.; George Mitchell Parker of New York, N. Y.; Gustavus Eliot of New Haven, Conn.; and James King Crook of New York, N. Y.

CURRENT PHYSIOLOGICAL THERAPY

JOURNAL OF ADVANCED THERAPEUTICS

New York, N. Y., April, 1905.

1. One Year's Work, with Selective Electric Harmonic Vibration — Morris W. Brinkmann.
2. The Therapeutical Application of the Continuous Current — T. A. Pease.
3. Further Research in Tuberculosis — J. D. Gibson.
4. Some Experience in the Use of High Potential Currents — C. A. Northrop.
5. A Case of Hyperidrosis Axillæ treated by the X-Ray — G. H. Stover.

1. Because of the fact that various cells in the body, notably those constituting the organ of hearing, respond differently to the different vibration wave lengths as represented by different musical pitches, Brinkmann has conceived the possibility that cells constituting other tissues of the body may also share this tendency, whereby different therapeutical results could be attained by regulating the pitch or wave length of the vibration.

He has had constructed a faradic coil with three separate interrupters, so arranged that a current, interrupted at the same time by different frequencies, may be administered. He reports that therapeutical results attained with this apparatus are very much better than those attained with the ordinary coil, which gives a current with but a single frequency of interruption at a time, and promises to exhibit a finished and perfected apparatus, and describe clinical results at greater length, in the near future.

2. See THE ARCHIVES for April, 1905.

3. Gibson considers that the great therapeutical elements in the treatment of consumption are the forcing of nutrition to the highest possible point, a

plentiful supply of sunshine, of air rich in ozone, and the locating of the patient in a dry altitude. If the patient's heart action is good he should be sent to the Rocky Mountains, which he considers the place *par excellence* for such a person to rest up and get well in.

Anything that increases metabolism and the assimilation of food, such as electricity, etc., are most useful. He considers the X-ray to be a most valuable adjunct; recommends that it be applied from a high tube and with a large amperage in the exciting coil, and that this application should always be stopped short of its destructive or enfeebling influence upon cell life. Its good effect is due to its power of increasing the blood supply of the part rayed, and it probably destroys bacteria secondarily by the increase of cell vitality dependent thereupon. He also recommends the use of artificial fluorescence in conjunction with the X-ray. Care should be exercised in cases advanced to the stage of cavitation, as febrile temperature and sepsis may be accentuated by too much raying.

4. A report of ten cases, commonly met with in general practice, and involving sciatica, local inflammatory processes, neuritis, and traumatic conditions, which Northrop has cured by the use of various static modalities. There is nothing new in the reports.

5. See THE ARCHIVES for April, 1905.

ARCHIVES OF THE ROENTGEN RAY

London, England, April, 1905.

1. On Osseous Formation in Muscles due to Injury (Traumatic Myositis Ossificans — Robert Jones and David Morgan.
2. The Treatment of Epilepsy by X-Rays — Horace Manders.
3. A New and Possibly Improved Method of using Radium — Hugo Lieber.

4. A Case of Severe Hysteria successfully treated by High-Frequency Currents — W. F. Somerville.
5. Reflections on the Position of Oscillatory Currents in Therapeutics, and the Present State of our Knowledge Concerning Them — T. J. Bokenham.
6. Note on Sanatoria for Insane Patients, James Murry Royal Asylum, Perth — A. R. Urquhart.
7. The Thyroid Gland: the Influence of Diet on its Structure and Function — Chalmers Watson.

1. Jones and Morgan report 17 cases of bony formation in the muscles about the joints, chiefly the elbow, following injury to the soft structures or dislocation. Over 250 such cases are on record. The type described differs from the successive ossification of muscles known as Myositis Ossificans progressiva, and that local ossification known as rider's joint, etc.

The pathology is not satisfactorily understood, neither is the origin of the bony mass. It is not, however, due to the transformation of the effused blood into bone. The periosteal theory explains a large number of these cases. Thus, in injury, a flap of periosteum may be torn entirely free, and be deposited in a muscle area; there, under the stimulus of the injury, it goes on to proliferation and ossification. Moreover, the wounded periosteum remaining on the bone also reacts and forms new bone. In this way a complete bony wall may be formed around the effused blood, and a cyst formation occur at the site of injury. This explains the frequent attachment of these bony tumors to the bone.

Again Boppe has advanced the theory, which was confirmed experimentally by Berthier, that if a muscle in action receives a blow some fibres may be torn off from the bone, carrying with them small portions of periosteum, which become true bone grafts.

Again a direct injury to undetached periosteum may be followed by a proliferation of bone into the muscle surrounding. The greatest number of these cases have their origin from the periosteum of the diaphysis of the bone, and in many such cases fine pedicles have been traced from the secondary bony deposits to the periosteum.

The article is to be continued and is illustrated by eight excellent radiograms, illustrating osseous formations in and about the elbow joint following injury.

2. Manders claims one person in every thousand throughout Europe is a sufferer from epilepsy, and he laments the inefficiency of medicinal treatment in the condition of *petit mal*, which is far more grave in its effects than the more amenable *grand mal*. Epilepsy has no definite pathology nor morbid anatomy. In an epileptic the cells of the gray substance of the brain or the upper portion of the spinal cord have not altered histologically in either way, either macro- or microscopically, and yet their reflex excitability is so exaggerated that the slightest irritation is sufficient in such individuals to set up a perfect storm of reflex excitability and action, which manifests itself as an epileptic attack. The cell change, then, is functional or dynamical.

Branth in America three years ago suggested the use of the X-ray in epilepsy, upon the theory that epilepsy depends upon the instability of the cellular brain elements or an abnormal metabolism. Since it is accepted by many authorities that the X-rays stimulate protoplasm into greater activity, they were on this theory applied in epilepsy.

Branth's technic consists of a tri-weekly exposure of 15 minutes at 15 inches, slowly increased to 10 minutes at 10 inches, a different part of the skull being exposed at each treatment. A tube backing a spark gap of from 5 to 8 inches is employed. The hair, of

course, suffers to a certain degree. The bromide which the patient has been taking should be withdrawn slowly. As a rule the patients gain weight rapidly. The seizures become lighter, occur at longer intervals, are of shorter duration, and followed by less prostration. Patients who have habitually suffered from six to eight attacks daily, after a few weeks' treatment may have but one attack in two or three weeks. Those patients in whom degenerative processes in the brain have set in are not amenable to this treatment. He reports at great length a case of mixed *grand* and *petit mal*, originating in childhood, developing fully in adult life, in a man aged 31, in which very decided benefit seems to have followed some 15 months' treatment.

3. Lieber describes a method of employing radium therapeutically. He claims that radium gives off about 95 per cent. *alpha* rays and about 5 per cent. combined *beta* and *gamma* rays. The *alpha* rays, as well as the emanations, are of no avail therapeutically if the radium is kept in a container. In order to get the maximum benefit from a given quantity of radium, it must be in such form that the walls of the container will not intercept either the *alpha* rays or the emanations, and the radium must be spread very thinly.

He claims that most of the disappointing results in the therapeutic use of radium have been directly due to the fact that the container intercepted a large proportion of the rays. By continued experiment he has succeeded in producing thin coatings of radium upon various rods of celluloid and instruments. The radium is dissolved in alcohol or amyl acetate, and into this solution the instrument or rod is introduced, is then withdrawn, and the solution evaporates, leaving the material coated with an exceedingly thin film of radium, which is then bound by dipping the in-

strument for a moment into collodion. This coating becomes so tough as to absolutely protect the radium, yet it is so thin as to permit *alpha* rays to emerge freely as well as the emanations. Moreover, the emanation of radium readily follows an air current; thus a hollow tube may be coated internally with the radium solution, and the emanations from the interior of the tube can be inhaled by the patient, or air can be forced through the tube by means of a compression bulb and applied to any of the cavities of the body. Rods, applicators, disques, drainage tubes, etc., may be prepared with a thin film of radium in this manner and employed on the surface or within the body. The radium is amply protected by means of the collodion coats, and the effect of objects so coated upon the tissues with which they come in contact is open to investigation by physicians.

4. Somerville's case was a female aged 35, complaining of mucous discharge from the bowel, external hæmorrhoids, and a sense of distension of the abdomen. She exhibited an obstinate ulceration of the leg, and at the age of 20 showed symptoms of gastric ulcers with hæmatemesis, and the passage of blood per rectum, and these symptoms, with loss of flesh and weakness, continued for 10 years, with occasional attacks of severe abdominal pain, attended with collapse so severe as to suggest perforation of the stomach. On one occasion the abdomen was opened for the purpose of repairing such perforation, but the stomach was found perfectly normal, without any adhesions. The gall-bladder, however, contained 27 calculi, and these were removed, but no permanent relief followed. Daily attacks of stomach pain, distension of the abdomen, general rigidity and unconsciousness followed for a year. Some improvement resulted from a sanitarium treatment by massage, baths, etc., but relapse was prompt.

One year following, Somerville began treatment with high-frequency currents, using auto-condensation, one terminal applied to a large abdominal electrode, the other to the couch. On many occasions this treatment gave immediate relief, gradually the severity of the attacks diminished, and they finally ceased.

For the treatment of the mucous colitis one electrode was applied to the tongue and the other was introduced into the rectum. Following this the hæmorrhoids shrank and the mucous discharge disappeared. The patient received 51 treatments, recovered completely, and has remained so.

5. Bokenham calls attention to the value of the work of Dr. Wright in classifying correctly the forms of oscillatory currents employed in therapeutics. The term high-frequency currents is inexact and should be discarded. The present attitude of the profession toward the employment of oscillatory currents in therapeutics varies from skepticism to total disbelief, and the results obtained are attributed to suggestion. He quotes Dr. Bonnefoy that most of the high-frequency apparatus should be classed as mere toys, few of them possessing therapeutic value. Too much has been written about results, and too little specific information concerning the exact current condition and technic employed.

Bokenham claims that our present knowledge does not permit us to describe this with scientific accuracy. He claims that the wide difference in the various styles of apparatus precludes the possibility of comparing the character of currents employed. Unless the self induction of the coil and the character of the secondary discharge is known, our knowledge is imperfect. We should have under control and be capable of determining: *A*, Current quantity; *B*, Tension; *C*, Wave-length; *D*, Wave-form; *E*, Frequency of oscillation; *F*, Rapidity, duration, and character of the interruption between succes-

sive wave-trains. This knowledge will prove a satisfactory solution of the problem. Doubt and confusion will disappear and much worthless apparatus will be discarded. He pleads for the measurement and recording of all factors connected with the work, but claims such measurements are deceptive; that the milliamperemeter reading is of value for a given installation, but affords no means of comparing different installations or as a guide to dosage for another worker; equally deceptive is the length or volume of effluve. Such measurements have only a relative, not an absolute value.

6. Urquhart claims the difficulty attendant upon the early diagnosis of phthisis is increased in asylum practice by the mental complication. Patients received free from tubercle have developed phthisis in the asylum. During seventeen years but ten cases of phthisis were under treatment in Murry's Asylum, all except one being diagnosed on admission. At this time a bad case was admitted from another asylum who was dirty in his habits and refused to adopt proper sanitary precautions. Following his advent six males developed phthisis, and a special sanatoria was added to the institution for the treatment of such patients with satisfactory results.

In spite of the particularly fatal combination of phthisis and insanity, the results under open air treatment have been encouraging. During the last 25 years 32 cases of phthisis in the insane have been treated; 14 died, 12 recovered physically, 2 improved bodily, 8 recovered mentally, one improved. Of 6 remaining, 5 have made physical recoveries, one remains under treatment. During the past 25 years the death rate from phthisis in this institution has been 6 5/10 per cent., and with the new sanatoria still more satisfactory results are expected.

7. Watson has made a preliminary investigation which has shown that dif-

ferent diets are associated with histological changes and alterations in the functional activity of the thyroid gland. A number of fowls were fed on a strictly raw lean meat and water diet, under which they died in from three to sixteen months. In each the thyroids were greatly enlarged, showing microscopically the characteristic appearance of simple parenchymatous goitre. In two cases the parathyroid glands were enormously enlarged, showing microscopically the normal structure of the glands.

In rats a diet of raw minced ox-meat and water, as much as they would consume, was given. The results were summarized as follows: Distinct histological changes in the glands. The parathyroids were generally unaffected. The appearance points to the condition of hypothyroidism with a probable modification in the character of the secretion. He believes that the dietetic habits of the country have changed markedly. The blue book shows evidence of an increased consumption of meat, which has probably been accompanied by indications of deranged function of the thyroid gland. Evidence is afforded in favor of this view in the value of thyroid medication in skin diseases, obesity, etc., which have no known relationship to the thyroid. He believes that in many subjects an alteration in the character of the thyroid secretion has followed this excessive meat dietary, and when a simple deficiency is present it can be remedied by administration of thyroid glands.

ARCHIVES D'ELECTRICITE MEDICALE

Bordeaux, France, March 10, 1905.

1. Case of Rebellious Psoriasis cured by Roentgen Therapie—Dr. H. Marques.
2. Tubes for Medical Radiology—Dr. J. Belot.
3. X-Ray and Wireless Telegraphy Automobile Ambulance—G. Gaiffe.

4. The Practice of Radiography and Radiotherapy in Germany—Prof. Jaime R. Costa.

1. The case reported is of a man 25 years of age who had suffered from psoriasis of a pronounced type of the hands, elbows, back, chest, and knees for four years despite treatment by oil of cade and other medicaments. The X-ray was applied at first to the hands. The author did not have Holzkecht's chromoradiometer at that time, but gives the following details: 12-inch coil; 110 volts; Contramoulin interrupter; soft tube; rays No. 5 or 6; anticathode at a distance of six and a half inches; exposure 5 minutes on the dorsum and 5 minutes on the palms of the hands. Treatments were given every two or three days. After two weeks the sound skin was decidedly erythematous, but the scales were falling off and the intolerable itching had entirely disappeared. This was all the treatment required for the hands.

Other affected regions were subjected to similar treatment and with the same success. Five months after the end of the course of treatment, which had taken only a month and a half in all, there had been no recurrence. The static breeze and high tension effluvia had been tried in this case without any effect.

2. A description by Belot of the different stages of development of the X-ray tube.

3. Gaiffe's automobile ambulance is run by a gasoline motor which can be used to operate a dynamo and one of his new transformers. The latter produces, without an interrupter, a current suitable for exciting an X-ray tube. All the necessary appliances for X-ray work and wireless telegraphy are included. This would be especially useful in country districts and in military surgery.

4. Prof. Costa continues his series of articles by describing the work done in Vienna, especially by Holzkecht, Kienbock, and Freund.

ARCHIVES D'ELECTRICITE MEDICALE

Bordeaux, France, March 25, 1905.

1. Radiography in the Diagnosis, Prognosis, and Treatment of Congenital Dislocations of the Hip — Dr. H. Judet.
2. Therapeutic Use of Salts of Radium — Dr. A. Beclere.
3. Comparative Study of the Action of the Autoconduction Cage and the Condenser Couch in the Treatment of High Arterial Tension by High Frequency Currents—Messrs. A. Moutier and A. Challamel.
4. The Practice of Radiography and Radiotherapy in England — Prof. Jaime R. Costa.

1. This is illustrated by several diagrammatic sketches from radiographs of the hip in cases of congenital dislocation both before and after reduction. His technique is to take a picture of the entire pelvis, with the tube over the linea alba at the level of the anterior inferior spines of the ilia, and with the feet symmetrically placed. This is followed by three radiographs of the affected hip, tube over a point 1 cm. external to the femoral artery and 1 cm. above the crural fold; in one the foot is in a sagittal plane, in another the foot is inverted resting on its inner margin, and in the third, everted. After reduction by Lorenz's method he finds it practicable to take a radiograph through the plaster of Paris by using a hard tube, resistance 15 to 18 cm. and an exposure of six or seven minutes, long and weak development carried to the greatest possible extent and disregarding all portions of the image except just the hip joint. The anatomical changes are very slight at birth, but become much greater after several years. He thinks the radiographs prove Lorenz's method to be a correct one.

2. The radium salts used in medicine are the chloride and bromide of radium, and the radio-active chloride and

bromide of barium which is more or less rich in radium. Salts of radium constantly emit rays like those from an X-ray tube. They also have the property of causing neighboring substances to become temporarily radio-active. The radiation is in straight lines not subject to refraction, reflection, or polarization and is arrested by a thick screen of lead. The induction of radio-activity is transmitted by the air and will travel through a narrow and sinuous tube; it must be due to a gaseous emanation.

The emanation of radium is not used therapeutically. Messrs. Bouchard and Balthazard and Mme. Curie have found that a certain amount of the exhalation mixed with air breathed by small mammals killed them very quickly. The ordinary containers for applying radium are transparent to the radiation, but retain the emanation. He reviews the properties of the alpha, beta, and gamma rays and the means of measuring radio-activity. From a therapeutic point of view the degree of activity is of much greater importance than the quantity of the salt, but the latter must also be taken into account.

Holzknicht's chromoradiometer is the most reliable measure of the therapeutic activity of salts of radium of different radio-activities and amounts, and in different containers. But this does not mean at all that an application of radium which will produce 5 H. has the same effect on the tissues as that of an X-ray tube producing 5 H. In his own application 15 centigrammes of 500,000 activity are spread out in a layer six or seventh-tenths of a millimeter thick and 11 millimeters square, and covered by a sheet of aluminum one-tenth of a millimeter thick. Measured by Benoist's radiochromometer the penetration of rays from radium is less than half of a degree; much less than the softest X-ray tube.

He reports a case in which he applied 45 centigrammes of pure radium bro-

mide in a glass bulb, for cutaneous nodules following removal of cancer of the breast. In one case the application lasted five and in the other ten minutes. In both cases there was a vigorous reaction, the longer application resulting in superficial necrosis which healed with a scar; but in neither case was any marked change produced in the cutaneous nodules. X-ray treatment would have caused the complete disappearance of the nodules without any effect on the surface of the skin.

After applying radium rays there is a pre-reaction the same day or the following day (redness, smarting, and itching); and then often after several weeks the true reaction appears.

Therapeutic uses are in three classes of cases.

1. The Algias. 2. Arthropathies. 3. Malignant disease of the skin or mucous membranes (in those cases where the lesion is of slight extent and depth and whose anatomical site makes the application of the Roentgen ray difficult).

3. The tabulated experiments of Moutier and Challamel show that in cases of high arterial tension the sole-noid (autoconduction cage) is decidedly more effective in lessening the arterial tension than is the autocondensation couch. As an example, in one case the arterial tension was 23 mm. of mercury; after treatment with the cage it was 17 mm. of mercury; after treatment with the couch it was 20½ mm.; after a second treatment with the cage it was 16½ mm.

4. The dominant personality in electrotherapeutic circles in London is Dr. Lewis Jones. He is assisted at St. Bartholomew's Hospital by Dr. Hugo Walsham, who has so well described the radiography and radioscopy of the thorax. Small coils of eight or ten-inch spark length are used generally with a MacKenzie Davidson mercury interrupter. The static machine is but little used for X-ray work. A milliamperemeter measuring the current passing through the

X-ray tube is the usual instrument for determining the quantity of X-radiation, Holzkmacht's chromoradiometer not being used to any extent.

JOURNAL DE PHYSIOTHERAPIE

Paris, France, March 25, 1905.

1. Roentgen Therapy in Ulcerative Cancer of the Breast — Dr. Haret.
2. Electrotherapy in Neurasthenia — Dr. E. Albert-Weil.
3. The Treatment of Dermatoses by Radium — Dr. M. Danlos.

1. Haret reports the case of a woman 64 years old, with a carcinoma of the breast which had existed, untreated, for four years. The nipple was still intact, but above it was an ulcerated mass the size of a Tangerine orange. There were no glandular involvements in the axilla, but cough and cachexia led to the suspicion of intra-thoracic metastases, and these were found on making a fluoroscopic examination of the chest. The prognosis, as far as concerned the local lesion, was good, but the X-ray was not expected to arrest the internal metastases. Treatment was by the administration of 4 Holzkmacht's units once a week. After three weeks the surface ceased to bleed; then the pain disappeared; little by little the surface of the ulcer became cleaner and its borders less thick; cicatrization began at the ninth treatment. A complete local cure was obtained in sixteen treatments — 64 H. — but the patient's general condition continued to become gradually weaker. Photographs are given of the condition before and after treatment. He considers this a case in which the patient would have been saved if X-ray treatment had been begun before internal involvement took place.

2. The first few electrical treatments in a case of neurasthenia should be quite mild. Albert-Weil recalls a

case in which the first treatment, by a static bath and a series of sparks along the spine, kept the patient awake all night. The most generally useful application is the effluvia of high frequency from the bipolar resonator. A metallic electrode from the upper pole of one of the resonators is applied to the nape of the neck while the effluvia from the other electrode (connected with the upper pole of the other resonator) is applied over the abdomen. The maximum effluvia is used and the application lasts fifteen minutes. Then the electrodes are changed and the effluvia applied up and down the spine for ten minutes. These treatments are repeated daily for twenty days. The static bath is the best thing when insomnia is a prominent symptom. Generally two or three series of twenty treatments each are required to effect a cure. In some cases a galvanic bath, with the hands in two basins connected with the positive pole and the feet in two basins connected with the negative pole, effects a complete cure.

For cerebral neurasthenia ("banded" feeling about head and inability to work) cerebral galvanization, large positive electrode on the nucha and a negative electrode, 5 cm. by 10 cm., on the forehead, the current very gradually and steadily turned up to 20 milliamperes, duration fifteen minutes. For occipital headache, static bath for ten minutes, preceded by high tension effluvia for twenty minutes applied locally. Arterial hypotension relieved by bipolar effluvia of high tension current for fifteen minute applications. When the blood pressure is very low indeed an electrode from the lower pole of one resonator is placed on the epigastrium and a series of spark discharges along the spine from a ball electrode from the upper pole of the other resonator. For cardiac troubles (palpitation, irregularity, and angina) static bath with a breeze over the heart. For dyspeptic troubles

especially of the nature of gastric asthenia, generally the regular high frequency effluvia over the stomach with the plate electrode over the spine, suffices; if not then Beard and Rockwell's galvanization of the sympathetic nervous system is to be applied. A negative electrode of 100×150 cm. is placed on the epigastrium, the positive sponge electrode placed over exciting points of the pneumogastric and sympathetic nerves on each side for five minutes, and then for the same length of time at each side of the cervical vertebræ, 8 to 10 milliamperes.

Constipation in these cases is nearly always spasmodic; treatment heavy galvanic or galvano-faradic currents. Difficulty of micturition in the male sex, galvanism, positive electrode on perineum, large negative electrode over abdomen or over the last dorsal vertebræ, the heaviest current that can be borne for ten minutes. Impotence, high frequency bipolar effluvia with a series of sparks over the erector center; or galvanism, large positive electrode over genitary centers of the spine labile application over the perineum, scrotum, spermatic cord, and the root of the penis, 10 or 20 milliamperes for 15 minutes every day. In women, pelvic neuralgia; vaginal faradization, the other electrode on the abdomen, fine wire coil and very rapid interruptions. Or especially the static induced current, one pole in the vagina (connected with Albert-Weil rheostat) the other on the abdomen, and the unoccupied hand of the operator massaging the abdomen. Myasthenia: rhythmic galvanism, positive electrode in the dorsal region, small negative electrode exciting the different motor points of the muscles of the limbs and trunk; 20 milliamperes, interruptions made by a metronome, duration of each seance 10 to 15 minutes.

3. Danlos says that the thinnest sheet of aluminum (two-tenths of a millimeter in his disk) absorbs 80 per cent.

of the radiation from salts of radium of 300,000 radio-activity; and that an improvement consists in having the radium spread on the surface of the metallic disk and varnished over with a preparation which is impervious to moisture, but transmits practically all the rays. Application with the original glass bulbs containing radium of 20,000 activity applied for from six to thirty-six hours, produced a temporary redness at once, followed in from 5 to 20 days later by a macerated pale transparency of the epidermis with a redness of the deeper layers of the skin, then slight blistering and superficial necrosis with slowly healing ulceration which is usually painless. The metallic double-walled disks, which he has been using the last couple of years, produced redness in from five to ten minutes, and with this radio-activity of 20,000 the exposure is about one to three hours. The application is repeated in three weeks; for lupus the same point will require two or three applications, while a single application suffices to cure a small superficial epithelioma (with epithelial pearls). The application invariably causes a persistent cutaneous erythema. Tubercular lupus affecting small areas is readily cured by radium and the resulting cicatrix is especially immune against recurrence. With lupus erythematosus the case is quite different, the benefit being very transitory indeed.

For epithelioma with pearls, of small extent and superficial, radium is highly successful, a metal disk with 300,000 activity applied for from half an hour to an hour. A cure is effected quickly and painlessly and there is practically no scar. For little vascular *nævi* applications of an hour repeated if necessary every three weeks results in little smooth white cicatrices. He thinks the X-ray would be much better for more extensive lesions. Radium has a beneficial effect upon patches of psoriasis, but this is entirely transitory. It has no effect in hy-

pertrichosis, an application which is not strong enough to cause ulceration and scarring having no effect on the hair follicles. Leucoplasia of the tongue with painful fissures was somewhat benefited by the application of 300,000 radio-activity for half an hour or an hour, the effect being a slowly-healing and painful ulceration the size of the disk, but after healing the patient felt better although there was no great improvement in the local appearance. As to epithelioma of the tongue he regards the X-ray as better if the lesion is accessible, using tongue forceps if necessary. The use of a radio-active fluid, ingested or injected, is still speculative, perhaps trials on animals may produce more valuable results.

LE RADIUM

Paris, France, February, 1905.

1. On the Therapeutic Use of Radium Salts — A. Beclere.
2. Radium Bearing Veins of Issy-l'Eveque — Jaques Danne.
3. Study of Phosphorescence — L. Matout.

1. While the discovery of radium by the Curies was a conquest of French science, according to the author, comparatively few publications on the use of that material for therapeutic purposes have yet appeared in France.

He distinguishes carefully between the emanation from radium, and the various kinds of rays emitted, stating that it is with the latter that the present article deals, since usually the radium salt is so enclosed as to prevent the escape of the emanation.

The various well-known methods of detecting and estimating the rays are referred to, and the electrical method, preferred by physicists, is given prominence. The author lays special stress upon the importance of always knowing and stating the quantity of salt employed on any case, as well as its activity referred to that of metallic uranium, the

total effect being proportional to the product of these two quantities, when other conditions are maintained constant. Knowledge of the permeability of the containing vessel is also very important.

Also attention is called to the question as to the proper method to employ in the comparison of the activity of samples to be used in therapeutics. Will any of the known methods result in a knowledge of the real therapeutic effectiveness of various samples? Surely not since the methods are not quantitatively comparable among themselves. As with Roentgen rays, the tissues are affected in proportion to the absorption produced, and for this reason the doctor might better use a method of comparison based on the absorption of the rays by some substance similar to the skin. The chromoradiometer of Holzknacht of Vienna is suggested for this purpose.

The author describes some experiments with this instrument made in Curie's laboratory, the results of which justify him in suggesting its use by others. There are many corrections, however, to be applied to get strictly comparable results, especially if the Roentgen rays are also considered.

Some special devices for using radium for therapeutic effects are described in detail.

2. This article gives the result of the attempt of the author to discover new sources of the rare element radium. The chief sources thus far have been from uraninite and from carnotite, both minerals containing uranium. Both minerals, however, are comparatively rare and in an effort to discover radium elsewhere the author has found that certain lead-bearing deposits near Issy-l'Eveque in France contain radium to a marked degree. The chief source of the radium in this soil is shown to be pyromorphite or a phosphate of lead found in small crystalline masses.

It is to be noted, however, that these

radio-active lead minerals do not contain any uranium, though up to the present time no radium has been found except in the presence of uranium. In fact it seems to have been shown by Boltwood and others that in uranium minerals the radium present is always proportional to the quantity of uranium in the sample, indicating of course that the radium has been generated from the uranium.

The fact that the pyromorphite from Issy-l'Eveque contains no uranium, would of itself be evidence against this theory. The author, however, attempts to account for the fact in a way quite consistent with the theory, that in all cases radium is produced by uranium. He suggests that the radium found has been deposited in the pyromorphite in rather recent times by radio-active water. Much conclusive evidence is given to substantiate this view. The soil is very moist and permeable and from all the water sources in this vicinity the author reports radio-active products due to radium emanation. From some locations, so located as to avoid the action of the water in question, samples of the mineral show no evidences of radium. Neither do samples of the same mineral when taken from other more remote places. The geologic formation of the region where these radio-active samples of pyromorphite were found also favors the explanation given for the presence of radium.

3. In this somewhat long and comprehensive article the author gives a brief history of the development of our knowledge on this subject during the last 500 years. The phenomenon has long been observed in the case of diamonds. The recent discoveries of the several new radiations which have been shown to excite phosphorescence in many substances have given a new interest to the matter, and the article will be found very useful to those wishing to look up any phases of the subject from original sources.

The material is conveniently arranged under several heads, as follows:

I. Spontaneous phosphorescence, including phosphorescent light emitted by animals and plants.

II. Phosphorescence brought about by mechanical action, *i. e.*, by rubbing, by shock, or by fracture.

III. Phosphorescence by light, or

the effect resulting when certain substances are taken into the dark after having been bathed in a strong light. To the varying intensity of this phosphorescence the logarithmic law of decrease approximately applies.

The various varieties of this interesting subject are discussed at considerable length and detail.

ELECTROTHERAPY

THE REMOVAL OF IRON AND STEEL FROM OTHER PARTS OF THE BODY THAN THE EYE, BY THE USE OF THE GIANT MAGNET, WITH REPORT OF TWO CASES

Frank C. Todd, *Northwestern Lancet*, March 15, 1905.

Magnets, both small and giant, have been frequently used for the removal of fragments from the eye, but Todd recommends that the giant magnet also be used for the removal of fragments in other parts of the body, and for diagnosing such conditions. He uses for this purpose a heavy magnet swung from the arm of a movable stand. This magnet is so powerful that it will lift 400 pounds when connected with the 500-volt current. The power is perfectly regulated by a rheostat which is worked by the foot of the operator. He reports the following:

"Case I.—This case was referred by Dr. Spring, who had taken an X-ray picture, which he has shown tonight, showing the location of the foreign body, and he had endeavored, with the use of instruments, to find it. The foreign body was embedded in the muscular tissues of the forearm, and was a flat piece less than one-quarter of an inch in diameter at its largest part. Dr. Spring was unable to find it with the knife or other instrument. The application of the magnet to the wound at once caused pain (due to the movement of the foreign

body toward the magnet, thus proving the fact that a piece of iron or steel was buried in the tissues), and whenever the current was turned on this pain was pronounced. An application of cocaine was made completely anæsthetizing the parts, and the foreign body evidently worked its way out toward the magnet, and when the arm was drawn slowly away from the point of the magnet the tissues remained in contact with the magnet, being held there by the piece of steel which was attracted toward the point of the magnet. By the use of a knife the soft tissues separating the magnet point from the foreign body were severed, and the steel readily made its way through this path, and was found upon the magnet point.

"Case II.—This case was also referred by Dr. Spring, and was another patient with a foreign body embedded in the tissues of the wrist. Dr. Spring has seen the piece of metal with the fluoroscope, but it was still smaller than the piece removed in the other case, being sharply pointed like a needle, one-quarter of an inch long and about one-sixteenth of an inch in its largest diameter. It was removed in the same manner, but it was found best to direct the magnet so that the lines of force would bring it out point first in order to secure it without much cutting. This foreign body was so small that it would have been impossible to remove it without considerable dissection and much searching."

RADIODIAGNOSIS

A METHOD OF MEASURING THE X-RAYS

Milton Franklin, *New York Med. Jour.* and *Philadelphia Med. Jour.*, April 22, 1905.

Franklin discusses the shortcomings in the present methods of measuring X-radiance, and recommends that the power of the X-ray to ionize the air be utilized, through an electroscope, as a means of accurate measurement. He has devised such an electroscope with a proper case, so constructed and arranged that no ultra-violet rays or other sources of error can enter. The instrument is portable, and provided with a window which can be opened so that the X-ray can be allowed to enter the electroscope when desired. The measurement is obtained by noting the rapidity with which the gold leaf falls, which denotes the degree of intensity with which the air is ionized by the X-ray, thereby giving a measure of the intensity of the ray under observation. The method of using Franklin's special electroscope is as follows:

"1. The electroscope is charged by having brought into contact with the knob a rod of vulcanite which has been electrified by friction. The knob is brought into communication with the filament, while the vulcanite is in contact, and released as soon as the filament has assumed a horizontal position.

"2. The electroscope is brought to the same distance from the tube as the patient or plate (in any position), and, while the tube is running, the shutter is opened and the time in seconds, occupied by the filament in transit, is noted. The number of seconds is the exact coefficient of energy of the rays, and when compared with any other reading made under any circumstances whatever, with a similar instrument, the ratio of energy of the two radiations will equal that of the two times."

BINOCULAR RADIOGRAPHY

Charles D. Harrington, *Northwestern Lancet*, April 1, 1905.

The stereoscopic radiograph was first suggested in this country in 1896. It gives you the X-ray *picture*; there is no distortion, and the full detail is seen at a glance. The author describes an instrument designed by Dr. W. S. Fullerton of St. Paul, which consists of an adjustable table, having attached to it a compression diaphragm. The essential points are the arrangements to move the tube definitely two and a half inches, and to remove the plate and replace it with another without moving the patient. The author then describes the Weigel stereoscope, which has been previously described by Dr. Weigel in the *New York Medical Journal* of November 16, 1901. The advantage of stereoscopic radiography is that it gives perspective, or the third dimension of space, in addition to length and breadth, which last *only* are attainable with the ordinary skiagraph.

AN IMPROVED X-RAY FOR THE STUDY OF BONE INJURIES AND FOREIGN BODIES

G. H. Stover, *Jour. A. M. A.*, March 25, 1905.

In the ordinary skiagram information is furnished of but two dimensions of the object under investigation, viz., length and breadth, but no information is furnished as regards the third dimension, depth or perspective. By the use of the stereoscopic principle this third dimension is supplied, and facilitates greatly the study of the actual relative positions of the different parts of the body under examination. The instrument recommended by Stover for the production of

stereoscopic skiagraphs is as follows: "A plate-holder so arranged that a plate in its light-proof envelope can be inserted, withdrawn and another inserted without disturbing the patient, who is placed on it, is quite necessary.

"If there are no good natural landmarks near the part to be examined, a metallic marker may be placed on the skin, its location being indicated by indelible ink or nitrate of silver; in looking for a needle do not use a piece of straight wire as a marker, and if a bullet is sought, do not use a metallic disk, for very obvious reasons.

"The tube is hung from a graduated support; a point on this support is found that is in a line perpendicular to the plate and passing through the center of the object to be examined. The tube is now placed so that the anode is a certain distance, varying according to the thickness of the part, to one side of the base point already selected on the tube support; an exposure is made, the plate withdrawn from the plate-holder, and another plate inserted. The tube is then moved so that the anode is on the other side of the base point of the support, a distance equal to its former distance from it on the opposite side and another exposure is then made.

"For examination, the finished plates

are placed in a suitable light, side by side—there is a right and left in this arrangement—and they are then examined by means of a special stereoscope. I use plane prisms of 12 degrees, with bases out; an ordinary parlor stereoscope will not do at all.

"In looking at the skiagrams, the attention is concentrated on the center of the picture, and the observer is rewarded by a view of the parts that gives their true perspective. There are other means of examining these negatives, but I think this is the simplest." By reducing the radio-stereograms in size they may be viewed through an ordinary parlor stereoscope, but they all suffer some loss of detail in the process of reduction. If one is able to diverge the eyeballs these radio-stereograms can be examined without the aid of a stereoscope, but not every one is able to accomplish this feat. The way to attain divergence is to attempt to look through a point midway between the negatives or prints, at the same time focusing the eyes for a distance far away.

Stover believes that the time is close at hand when failure to apply skiagraphy as an aid in the diagnosis and treatment of fractures and dislocations will be considered evidence of neglect and incompetent treatment.

RADIOTHERAPY

CARCINOMA OF EYELID CURED WITH LIGHT TREATMENT

Dr. Greef, *Berliner Klinische Wochenschrift*, 27, II, 1905.

The patient, who was 67 years old, noticed 15 weeks before, on the inner angle of the upper lid, a small pustule which very rapidly increased in size. Greef found a big, ulcerating "canceroid" reaching from the right eye across the nose to the lids of the left eye. The lids of the right eye were almost

totally destroyed, the cornea cloudy, the bulbus blind. A microscopical examination corroborated the diagnosis of carcinoma (not the variety known as *ulcus rodens*). The bulbus was enucleated, and five days later the whole ulcerating area exposed to the Roentgen rays. Duration of each sitting, ten minutes. After eight applications the whole area was transformed into white, hard, cicatricial tissue, and the carcinoma cured. A plastic operation followed with a gratifying result.

TUBERCULAR TESTICLE AND THE X-RAY.

W. D. De Garmo, *Medical Record*, April 15, 1905.

Report of a case of tuberculosis of testicle cured by means of the X-ray.

This man was 56 years old, large and robust, and always had enjoyed the best of health. Admitted gonorrhœa 25 years before. One of his testicles suddenly began to swell and gave him increasing pain. He took the European trip to try the baths for it, but received no relief. He began to lose weight rapidly, and a diagnosis of tuberculosis of the testicle was made. Operation was advised and consented to after two months. Pathologists reported a "typical tuberculosis." The patient made a prompt recovery, but immediately afterward showed evidence of disease in the left testicle, and after trying an outdoor life for two months, presented himself with a testicle as large as the other had been. An operation was suggested and refused, and he was referred to Dr. F. D. Carpenter for X-ray treatment.

One hundred and twenty-six treatments of ten minutes each with a medium tube at ten inches distance was given. Pain left at the first application; swelling and tenderness gradually subsided until at the end of the last treatment the testicle was apparently normal in size.

The statement that no other cases are on record is an error, as 21 cases of tuberculosis of the testicles were reported in *American Medicine* for January 14, 1905, by Dr. James Bullitt of Louisville, who reported 33 per cent. cured, 48 per cent. improved, with 19 per cent. as failures.

The author claims epididymectomy had cured many cases, but claims it should be used with caution, owing to the mental effect upon the patient.

He calls attention to the alleged danger of sterility of the individual from radio-active therapeutics, but justly

claims that the danger is very remote where this disease exists, as the damage has already been done.

The very full report that is made of this case by the doctor is very welcome to X-ray operators, as there have been so many cases reported where the reports were open to serious question as regards both diagnosis and details of treatment.

LEUKEMIA. THE ULTIMATE FAILURE OF THE ROENTGEN RAYS AS A THERAPEUTIC AGENT

Everett J. Brown and Cecil M. Jack, *Jour. A. M. A.*, March 25, 1905.

In the present state of knowledge regarding this disease, more especially as regards the place of the X-ray in its therapy, this article is most timely and of the greatest value. It completes the history of a case which was reported by the authors in the *Journal of the American Medical Association* for March 25, 1904, as symptomatically cured. The patient was a cigarmaker, unmarried, 30 years of age, who first came under the observation of the authors July 1, 1903. Family history was negative, except that one sister had tuberculosis. He did not use alcohol, but smoked moderately. There was no history of malaria or syphilis.

When the patient first came under observation he complained of physical weakness, pain in the back, and a feeling of weight and distress in the left side. Two years previously he had had a fall, alighting on the lower ribs of the left side, which compelled him to stop work for two days. He had had a slight cough for some time previously, and for six months had been troubled with palpitation, dyspnœa, and slight headaches. His feet had commenced to swell some.

He was moderately well nourished but looked somewhat cachectic. Weighed 169 pounds. Was slightly anæmic. Lymphatic glands were not enlarged,

except in the inguinal regions; was troubled some with palpitation. Heart and lungs normal, liver dullness extending to the edge of the ribs, and the edge of this organ was easily palpable. Splenic dullness begins on the seventh rib in the midaxillary line, and extends one finger's breadth beyond the median line. On palpation this organ was hard and smooth, but no notch could be felt. Pulse 90, temperature 99°F.

Urine gives a slight precipitate of albumin and a few casts were found. Red blood cells number 2,600,000, white cells 800,000, hæmoglobin 65 per cent. Slight poikilocytosis was present, and many nucleated red cells. Differential count of the leucocytes gives: Polymorphonuclears, 40 per cent.; myelocytes, 40 per cent.; eosinophiles, 8 per cent.; large mononuclear with basophile granules, 8 per cent.; degenerates, 4 per cent.

Diagnosis, splenomyelogenous leukemia. He was given arsenic and iron internally and X-ray treatment to the splenic region twice a week; technique of the radiations not given.

Two months later patient had improved to such an extent that he returned to his work. He had a good appetite, had gained in weight, spleen had decreased in size, and a notch was felt for the first time. Edema of ankles less. Leucocytes decreased to 58,000, with an increase in the corpuscles to over 3,000,000.

Iron and arsenic were then discontinued, and the X-ray exposures were given daily, to splenic region, the ends of the long bones, and to the sternum. Four months after beginning the treatment the leucocytes numbered 129,000, red cells 4,124,000, hæmoglobin 85 per cent; there was very little variation in size and shape of the red blood corpuscles and no nucleated forms were found. Myelocytes, 25 per cent.; polymorphonuclears, 60 per cent.; eosinophiles, 5 per cent.; small lymphocytes, 1 per cent.;

degenerates, 3 per cent.

In February, 1904, or seven months after treatment had been begun, "the albumin had all disappeared from the urine, and the patient weighed 182 pounds, which is more than he had ever weighed before. The spleen could only be felt on deep palpation. Treatments were reduced to every other day, and the patient was advised to take long walks on the intervening days."

On May 1, 1904, the appearance of the patient was "that of robust health. His complexion is florid, quite a contrast to the cachectic appearance of ten months ago. He is working daily and rides his bicycle back and forth from work. The liver is of normal size, and the spleen is not palpable even on deepest inspiration. The ankles show no edema. His weight is 184 pounds. The abdominal parietes are relaxed, but there is no ascites. The previous inguinal adenitis has entirely disappeared."

On July 1, the patient's good health had continued and the leucocytosis had reduced to 11,000, 7 per cent. of which were myelocytes.

In September, 1904, or fourteen months after treatment was begun, patient began to complain of weakness and pain in the back and the leucocytosis ran up to over 50,000; a few hyaline casts were found in the urine. From that time on the spleen became larger, a marked diazo-reaction was present in the urine, widal test was negative, and delirium developed. Within a week the leucocytes dropped to normal, and a severe diarrhea developed. Bowel movements contained some blood and much pus. Diazo-reaction still present and the urine contained albumin, numerous hyaline casts, and a moderate amount of calcium oxalate crystals. The low typhoid state continued for two weeks, the condition being a semi-delirium with great emaciation, no apparent suffering, no edema. Death occurred November 15, sixteen months after beginning treat-

ment.

The findings at the autopsy, which was performed seventeen hours after death, are so interesting, instructive, and significant that we transcribe them *verbatim* as follows:

AUTOPSY

"The subject is a man of average size. Skin pale and sallow; muscles small and emaciated; panniculus almost absent. Both pleura free and no fluid in pleural cavities. The heart is of normal weight, its endocardium slightly thickened; muscle is firm and of a brownish-red color. The auricles contain ante-mortem clots and the ventricles fluid blood. The valves are normal. The lungs show marked anthracosis and yield slight exudate on pressure. There are no airless areas, but a slight hypostasis over lower lobes. The bronchi are empty and the mucosa pale. The spleen weighs 1,133 gms. and measures 15 x 9 x 6 cm. There is one notch. The capsule is greatly thickened and cuts with resistance. The cut surface is firm and dark bluish-red in color. The stroma is greatly increased, but the malpighian corpuscles are not visible.

"The liver is enlarged but firm. The left lobe is atrophic. The veins of the capsule are congested, the capsule being thickened. On section the organ is fairly rich in blood. The cut surface is granular, brownish-red in color, and the outline of the lobules is distinct.

"The fibrous capsule of the kidneys strips off easily. The surface is slightly pale. On section the labyrinth and the medullary rays are distinctly outlined. Connective tissue is increased.

"The stomach is in normal position. Walls are pale. The small intestine shows no ulcers. The mucosa is pale. No enlarged glands in the mesentery. The rectal walls are much thickened and the mucosa is pale. The retroperitoneal glands are not enlarged.

"*Pathologic Report.*—The follow-

ing pathologic report was kindly made for us by Dr. A. S. Warthin of Ann Arbor, who is now doing much experimental work in this line:

"Lung: There is moderate chronic passive congestion; there is some atrophy, and the smaller bronchi are somewhat dilated. The number of leucocytes in the blood vessels is not perceptibly increased. Lung does not show the characteristics of lung from case of leukemia.

"Spleen: Marked fibrosis. There is a fibroid hyperplasia of the reticulum of the pulp closely resembling that of splenic anemia. There is marked chronic passive congestion, the venous side being greatly dilated and filled with blood. Follicles are not preserved. The cells of the pulp are chiefly of a fibrous-connective-tissue type or endothelial. Lymphocytes are relatively very few. Cells of the type of large lymphocytes are more numerous. There are numerous large atypical cells of the endothelial type. There are few eosinophiles, and no myeloid changes. Leucocytes are relatively few in the blood vessels. The general picture resembles that of a spleen of splenic anemia and not that of a leukemic case.

"Liver: There is atrophy, chronic passive congestion, and some parenchymatous degeneration. Connective tissue is relatively and in some areas absolutely increased. There is no leukemic infiltration. Glisson's capsule is somewhat more cellular than normal, but the cells are chiefly of a connective-tissue type. Leucocytes are not increased in vessels.

"Pancreas: Post-mortem change. There is some atrophy, with slight fatty infiltration. There is no leucocyte infiltration. Leucocytes are not increased in vessels.

"Small Intestine: There is slight atrophy and there are a few lymphoid elements. There is no evidence of leukemia.

"Large Intestine: Small chronic ul-

cers are present. There is no evidence of leukemia.

"Kidney: Sections of the kidney show remarkable lesions in the form of extensive deposits of lime salts, involving chiefly the convoluted tubules. For the greater part these tubules are replaced by masses of lime salts, either completely filling up the tubule and replacing the epithelium or confined to the epithelium alone, either partly or wholly surrounding the lumen of the tubule. Some glomeruli show small deposits, and casts of lime salts are found also in the straight tubules. The deposit is, however, for the chief part, in the convoluted tubules. Such convoluted tubules as are in part free from lime salts show more or less parenchymatous degeneration. Localized areas of acute interstitial inflammation are also present and hyaline casts are found in some straight tubules. There is no leukemic infiltration and no increase of leucocytes in the blood vessels. The general picture closely resembles the parenchymatous changes with deposit of lime salts seen after poisoning with mercuric chlorid.

"Lymph Glands: The small lymph glands show a lymphoid hyperplasia resembling that of lymphatic leukemia or of some of the cases reported as lymphosarcoma (aleukemic leucoblastoma?). The distinction between cortical and medullary portions is lost, the sinuses are filled with or obliterated by lymphoid cells, and the gland presents an almost uniform lymphoid structure. No germinal centers are found. The capsule in many places is infiltrated, and such infiltration extends also beyond the capsule into the surrounding fat tissue. There are no myeloid changes. Numerous large lymphocytes are present throughout the gland. There are a few eosinophiles. Leucocytes in surrounding vessels are not increased.

"Summary.—The only pathologic finding suggestive of leukemic disease is

the condition of the lymph glands. This resembles the gland picture seen in some cases of lymphosarcoma (aleukemic leucoblastoma?) or that of a lymphatic leukemia minus the increase of mononuclear elements in the blood. The spleen picture is of the same type as that of the splenic fibrosis of splenic anemia. Counts made of the leucocytes in the vessels of all the sections show an unusually high percentage of mononuclears. Because of the fixation, these cells could not be satisfactorily studied. There is, however, nowhere any increase of leucocytes in the vessels suggesting the existence of a leukemia.

"The calcification existing in the kidney is remarkable for its extent. It would suggest the occurrence of an intoxication causing degeneration or necrosis of the epithelium of the convoluted tubules followed by deposit of lime salts, such as occurs in poisoning with mercuric chlorid, chromates, etc.

"Remarks.—The post-mortem findings in this case are very interesting in connection with the experimental work that has been done by H. Heinecke, and also the work now being done by Warthin which he will soon publish. Heinecke found that a brief exposure of mice, rabbits, and dogs to the rays induces a distinct destructive process in the lymph follicles. With an exposure too brief to induce changes in the skin, he could cause a distinct destruction of the nuclei of the leucocytes in the follicles of the spleen, leading to their almost complete disappearance. Analogous processes took place in other lymphoid elements. His remarks on the changes in the bone marrow are not clear except that some destruction of lymphoid elements took place. These experiments might suggest a physiologic basis for the use of the X-ray in leukemia, so far as the excess of white cells in the circulating blood and the presence of abnormal cell elements are concerned, and they compare most favorably with the results in our case.

Undoubtedly the X-ray has a selective action, apparently affecting tissue undergoing pathologic hyperactivity and causing degeneration and necrosis of such tissue; however, the damage done is apparently greater than the good.

"Dr. Warthin, in summing up the pathologic findings, says: 'If any conclusion is warranted from the study of the specimens, it would seem to be that the X-ray treatment has resolved the leukemic condition into an aleukemic state, but that the essential disease process, as evidenced by the condition of the lymph glands, is still active. The leucocytes have been removed from the general circulation and from the areas of infiltration, the spleen presenting the characteristics of a chronic fibrosis. The part played by the latter would appear to be secondary. The remarkable condition of the kidneys offers room for some speculation as to the source of a toxin. Such might result from the destruction of enormous numbers of leucocytes.'"

The authors regret that no specimen of bone-marrow was obtained because, as it is generally believed that this disease is located primarily in the bone-marrow, no real conclusion can be arrived at until this part of the subject has been thoroughly studied.

THE TREATMENT OF LEUKEMIA WITH ROENTGEN RAYS

Erich Meyer, *Berliner Klinische Wochenschrift*, 13, II, 1905.

The author reports two cases of leukemia treated with X-rays. Case I was radiated from May to December. In May the temperature was over 100, the spleen extended to the right side, the liver below the navel. The leucocytes in May numbered 152,000, in December only 2,300-2,600.

Case II was a young girl with a large

tumor of liver and spleen. The leucocytes before radiation were 420,000; when patient left the hospital, 140,000. The size of liver and spleen had only slightly decreased, but patient felt so well that she soon after accepted a position. In this case the radiations had to be stopped several times because she complained of pains in the spleen.

In the discussion Von Raake reported a case of a 13-year-old girl, which so quickly improved that on November 8th, the day of the first irradiation, the leucocytes numbered 350,000; on December 10th, only 32,000.

FURTHER REMARKS ON THE TREATMENT OF TRACHOMA WITH RADIUM

Hermann Cohn, *Berliner Klinische Wochenschrift*, 20, II, 1905.

Cohn gives the advice in trachoma to be careful with radium and employ only a small quantity, about one milligram for from one to two minutes. He has had good results in seven cases without any detriment to the eye or the eyesight.

FLUORESCENCE ARTIFICIALLY PRODUCED IN THE HUMAN ORGANISM BY THE X-RAY, BY RADIUM, AND BY ELECTRIC DISCHARGES, AS A THERAPEUTIC METHOD

William James Morton, *Journal of the A. M. A.*, April 1, 1905.

The method described by Morton involves the administration to the patient of solutions of substances which fluoresce (or phosphoresce) when subjected to the influence of the X-ray, radium radiations, and radiant electric discharges. By internal administration of such solutions the patient's whole system is satu-

rated thereby, and when any light capable of exciting fluorescence is applied the tissues so saturated will be flooded with the fluorescent light as deeply as the exciting radiations can penetrate. He does not mean to imply that the fluorescence is light of the same wave length as that from the exciting source; it is, on the contrary, of a wave length considerably lower than the exciting source, but still akin to it in its property of being susceptible of refraction and dispersion, as are the violet and ultra-violet rays. These secondary radiations in their turn set up fluorescence.

Morton has used the method principally in deeply-located malignant processes, tuberculosis, etc., for which reason he has found it necessary to use the X-ray instead of the arc light as an exciting agent, because the latter would not penetrate deeply enough to be able to excite the fluorescent phenomenon in the deeper tissues. The electric arc light, therefore, would only be valuable in this method with lesions so superficial that the relatively feeble penetrating power of this light could be made to go clear through them.

Some of the tissues of the body are more or less fluorescent naturally, and in some diseases this natural fluorescence has been found to be diminished. It is therefore reasoned that some medicines, which are of a fluorescible nature, may exert their beneficial influence by restoring to the tissues of the body their normal fluorescibility. As an instance may be mentioned the use of quinine in malaria. Quinine is fluorescible, and in malaria the fluorescence of the blood is markedly diminished; by the administration of this drug, therefore, the impaired fluorescence would be restored, and the action of the daylight would be to excite the fluorescence, which might have a lethal effect upon the plasmodia. The fact is well established that quinine solutions, when subjected to light, exert a deadly influence on some micro-organ-

isms. Ullman, for instance, found that paramacia, when immersed in solutions of quinine, one to twenty thousand, are killed in eight minutes if exposed to the light, but only after five hours when so immersed and left in the dark.

A very convincing demonstration that the tissues saturated with fluorescent solutions become fluorescent under the influence of the X-ray is shown by skiagraphing the hand of a person to whom they have not been administered, and to one who has, under the same conditions. The skiagraph of the hand of the person who has absorbed the fluorescent solutions shows a greatly superior detail and clearness, more especially of the osseous structures.

In connection with this treatment Morton also administers to patients under treatment a tablespoonful of water, which has been rendered radioactive by exposure to the emanation from radium twice daily.

For the production of this phenomenon Morton employs quinine bi-sulphate in doses of from 5 to 15 grains daily; fluorescin solution, 1 to 30, from 6 to 20 drops three times daily an hour after meals; or from 5 to 15 grains of esculine daily. He has treated a good many cases by this method, and considers that it is a very valuable adjunct in the treatment of disease by the application of light. The article is summarized and concluded as follows:

"1. The excitation of fluorescence within tissue is a species of phototherapy and dependable on the same basis for curative effects. the term sensitization is not accurate, for it is not known what the term means. There is no proof that fluorescent substances make the cells or other micro-organisms vulnerable to the exciting radiation.

"2. What the fluorescent light lacks in intensity is compensated for by proximity to tissue.

"3. The methods of Tappeiner, 1900, followed by Dreyer, 1903, con-

sist primarily of superficial applications, or of parenchymatous injections submitted to the action of sunlight or to the action of the electric arc light.

"4. The method here outlined consists of a medicinal saturation of the entire blood system with a fluorescent solution and submission of parts or of the whole of the patient to the Roentgen and Becquerel radiations and to electric discharges.

"5. The method naturally includes filling cavities with fluorescent solutions, as well as using these solutions medicinally.

"6. This method is not of the same category as sensibilitization by Dreyer's method, for the process and the results are different.

"7. The curative effects obtained by this method are probably due to the fluorescent light.

"8. This method permits of an improvement in skiagraphic effects and of fluoroscopic examinations.

"9. Following the suggestions of the use of fluorescent solutions in diagnosis and treatment, the method has proved of value in determining the position and size of the stomach and other cavities of the body.

"10. The thoracic cavity presents on the fluoroscope a degree of illumination greater than that produced by the X-radiation alone.

"11. The method is useful in tuberculosis of the lungs, and in other cases of tubercular deposit, as well as in cancer."

X-RAYS AND STERILITY

F. Tilden Brown, M.D., and Alfred T. Osgood, M.D., *American Journal of Surgery*, April, 1905.

Before the January, 1905, meeting of the Section on Genito-Urinary Dis-

eases of the New York Academy of Medicine, the statement was made by the authors that men, through their presence in the X-ray atmosphere incidental to the practice of radiography, X-ray therapy, or the testing of X-ray tubes, may, after a period of time, be rendered sterile. This statement was based upon a discovery that ten X-ray workers who had consulted them were the subjects of azoöspemia, although none of them had suffered from any venereal disease or traumatism involving the genital tract, none of them presented physical signs of abnormality of these organs and none was conscious of, or gave a history of functional derangement. Since that time the number of cases has increased, and the authors now have records of 18 cases in whom total azoöspemia, or oligo-necrospemia, has been demonstrated. All of those examined who have done extensive X-ray work for several years (more than three) show no spermatozoa in the seminal fluid, while a few of the men who have been engaged in the work for a shorter time and have exercised care in avoiding direct exposure to the active tube show varying states of oligo-necrospemia.

This sterility has been produced without the slightest subjective or objective sign denoting its insidious development. In no case has even a transient erythema of the scrotum been noted, and in no case has there been evidence of deterioration of sexual activity. The writers quote from the experience of Albers-Schoenberg, Friebe, Phillip, Bergonie, Laponski, and others in support of their contention.

As to the vital question of prognosis, the writers hold that it is still in abeyance and must remain so until evidence can be collected as to the recuperative power of these organs and after months or years.

It is reasonable to suppose that some of the spermatogenic cells have escaped this blighting influence in many cases

where precautionary measures have been adopted or in those whose exposures have not been protracted or frequently repeated. The operator of Roentgen ray tubes should protect himself by working behind a screen impermeable to X-rays. He should expose himself only when absolutely necessary for examination of his tube, and then only for the shortest possible time.

Such screening may be accomplished by many of the tube shields of the market. Some of these shields, however, are of little real value and give a false sense of security. The responsibility of guarding against the injury of assistants, patients, spectators, and others who may be exposed, rests upon the men whose business it is to understand as fully as possible the injurious as well as the beneficial effects of the force which we have all marvelled at, during the ten years since Roentgen's discovery put into the hands of the medical profession this great aid to our diagnosis, and gave impetus to the development of a valuable addition to our therapeutic measures. We want to give this warning to those who are employing or will make use of

Roentgen rays: repeated, prolonged exposures of the testes does produce sterility in the human being. Adequate protection of all parts of the body not directly exposed for examination or treatment should invariably be provided.

X-RAY BURNS

L. R. McCready, *Virginia Medical Semi-Monthly*, April 7, 1905.

Medical literature contains very little of real value regarding the treatment of X-ray burns, but McCready gets good results by exposing the affected part to the action of the Minim light until the heat rays become painful. Then he covers the surface with a bland, unirritating, alkaline solution over which he places gauze and a close-fitting rubber bandage or adhesive straps. This dressing is removed once in 24 hours and reapplied. He prefers glycothymoline or some such alkaline solution for this purpose. It is important that some dressing be used which will remain wet for a long time.

HYDROTHERAPY

OCEAN BATHING

Philip Marvel, *Jour. A. M. A.*, April 18, 1905.

While the stimulation, due to a bath of from 15 to 30 minutes in the cool waters of the ocean, is beneficial to those whose vital powers are sufficient to enable them to respond actively, prolonged baths in the ocean and lying around upon the sand in wet bathing-suits is to be deprecated as tending to produce dangerous debility and lowering of physiological resistance. Marvel considers that the poorly-regulated, hap-hazard sea bathing indulged in along the

Atlantic coast is responsible for a vast deal of harm, and that physicians should raise their voices in protest against such disregard of the laws of health.

There are four elements which are physiologically active in sea bathing.

First, the percussive element due to the impact of the swells or surfs; second, the stimulation of nerve endings due to the difference in temperature between the water and the skin; third, the chemical irritation of the salt; and fourth, mechanical influence of the forced physical activity. In this way a

tremendous impetus is given to the fluids of the body and to the various reflex activities involved in metabolic processes.

Sea bathing is contraindicated with patients suffering from arteriosclerosis, organic heart disease, rheumatism, cholelithiasis, intestinal febrile disease, or any condition whatsoever in which the

normal physiological resistance has been sufficiently reduced to render necessary protection of the patient's vital forces. Miscarriage may be caused by bathing when the sea is rough and occasionally otitis media may be so provoked. It is also prejudicial to health during the menstrual period.

DIETOTHERAPY

THE DIETETIC USE OF PREDIGESTED LEGUME FLOUR, PARTICULARLY IN ATROPHIC INFANTS: WITH A STUDY OF ABSORPTION AND METABOLISM

David L. Edsall and Caspar W. Miller,
American Journal of the Medical Sciences,
April, 1905.

This paper, "read by invitation before the Buffalo Academy of Medicine, December 13, 1904," embraces the results of investigations, made under the auspices of "The William Pepper Laboratory of Clinical Medicine, Phoebe A. Hearst Foundation," concerning the value of predigested bean flour as a food for sick children. They were undertaken to determine (1) the feasibility of feeding vegetable proteids in the place of milk proteids to infants who have difficulty in digesting the latter; (2) whether the vegetable proteid has any different effect upon metabolism from that of milk proteid.

It was impossible to find in the market any satisfactory bean or pea flour. Therefore the investigators got white kidney beans, dried them, ground them in an ordinary spice mill, removing the shell, and using only the dry fine flour secured by bolting. Subsequently they had a larger quantity ground elsewhere. The flour must be very fine in order to facilitate predigestion, and also to soften and disintegrate the tough mass of cellu-

lose in which the proteid is enclosed, in vegetables when cooked in the ordinary manner.

A ten per cent. solution is then made by gradually adding water, and making at first a smooth paste, and later a mixture which can be easily stirred. It is then heated in a double boiler, at a good heat, for fifteen or twenty minutes, in the mean time being frequently stirred. It has then become a rather thick paste. It is next cooled to between 60° and 70° C., and the ferment added and allowed to act for ten minutes, while the stirring is continued. The mass then becomes perfectly fluid, and resembles a rather thin soup. In order to stop the action of the ferment, the fluid is brought to the boiling point. After being cooled it is ready for use.

The ferment used was generally cereo, but sometimes maltine. Probably any good diastatic ferment would do as well. The resulting fluid contains little, if any, iodine-reacting starch, and the proteid is largely in solution, and therefore from a physical standpoint in a condition very suitable for absorption.

In using this preparation it was customary to substitute it for a portion of the milk, as it had been given, appropriately modified according to the age and digestive power of the infant; but yet maintaining unchanged the food value of what he received. In some cases 25 per cent. of the modified milk

was replaced by the 10 per cent. solution of predigested bean flour, in amount 25 per cent. more than the amount displaced. That is, if the child was receiving 48 ounces of modified milk per day, 12 ounces of this was replaced by 15 ounces of the 10 per cent. solution of bean flour. Usually the food as given contained from two and one-half to three per cent. of bean flour. Three per cent. of bean flour indicates sixty-five one-hundredths of one per cent. of proteid.

Careful observations on two infants, extending over several days, showed that the nitrogen absorption did not differ very materially when a portion of the modified milk was replaced by the bean-flour preparation in the way just indicated, and that the bean proteid was absorbed fully as well as the milk proteid.

Further investigations, made upon one child and one adult, seemed to show that the influence of bean proteid upon metabolism was quite as satisfactory as that of other proteids, and to confirm the observation, made by others, that it is possible to maintain a nitrogen equilib-

rium, and sometimes to produce a nitrogen retention, on a vegetable diet.

The clinical results obtained in 28 cases were decidedly encouraging. Most of the children showed marked improvement, both as regards the activity of the function of digestion, and also as regards the general nutrition, as indicated by an increase in weight.

This bean flour, in which the starch has been predigested by a diastatic ferment, furnishes the means of giving an extremely concentrated food in fluid form and partially digested. A 25 per cent. solution, although fluid, is practically equivalent to beef steak in nutritive value.

Infants take the bean flour solution with milk, in the way described, very readily after one or two feedings; but to older children and to adults, especially when given without milk, it quickly becomes exceedingly distasteful. This objection can, however, probably be generally overcome by the exercise of some ingenuity in flavoring the solution, as was done in the case of one adult by adding cinnamon as a flavor.

MECHANOTHERAPY

TECHNIQUE AND EFFECTS OF MASSAGE

Volume VII, Chapter I, Cohen's "System of Physiological Therapeutics."

This article is a notable addition to the knowledge of mechanotherapy. It deals with a method of passive exercise which is little understood or used in this country by physicians in general, yet which forms an important part of the armamentarium of some of the famous practitioners of the day. It is just as necessary to understand the proper indications for massage, and to have it skillfully applied, as it is to possess a thorough knowledge of drugs and a

competent pharmacist to dispense them.

Massage is defined as a form of passive exercise by systematic manipulation of the body for definite therapeutic ends. If properly used it may affect in various ways the nervous, circulatory, digestive, and muscular systems. The movements accomplish much the same results as active exercises, but the latter are not always possible however much they may be needed. The patient may be confined by injury, or he may have organic defect of the heart that requires the relief of peripheral resistance to the blood flow if the circulation is to be maintained in efficient form, or the nervous system may be so deranged that a series of reflexes

must be set in motion that will control and normalize its action before any fair approximation to health can result. The method of passive use and manipulation is also of high utility in maintaining the quality of a muscle that has been temporarily deprived of its natural nerve stimulation, as in Bell's paralysis of the facial nerve where serious deformity is likely to result if the circulation and muscular tone be not sustained by this means.

A strong blow is struck at the absurd claims of quacks who claim certain "electric" power or "magnetism" that produces wonderful effects on the patient at the expense of the masseur. The most efficient masseur is the person who has been so trained that he works to the best advantage and uses no more strength than is needed, and who has such a surplus of power that he is not exhausted by any amount of work that any fairly able-bodied man should do without complaining.

The personal requirements of an operator are physical strength trained to do the will of a trained mind, a hand that is soft and delicate in its touch and yet that is capable of vigorous action, a skin that is clean and warm, and a manner that is quiet and courteous.

The value of massage is entirely dependent upon the manner of its execution and is therefore to be definitely pre-

scribed by the physician, as to the character of the movements applied, their duration, and force. The neglect of this precaution is like turning over the dosage of drugs to a nurse.

The movements are classified under the four heads used by the French masseur: Effleurage, Petrissage, Friction, Tapotement.

Some twenty excellent illustrations are inserted in the text that show the application of various forms of movement to different parts of the patient. The remainder of the chapter is devoted to the indications for and the contraindications to massage and this, to the average physician, is the most valuable part. In the first category is placed the strengthening of muscles, skin stimulation, promotion of digestion, increase of intestinal action, improvement of circulation, arousing sluggish metabolic processes, etc., and in the latter category are placed fevers, breaks in the skin, pus formations, malignant tumors, cysts, menstruation, etc.

Mechanical massage receives only a brief notice, as it is clearly not in the province of the writer to discuss every method of applying movements to the body, but the most expert and adaptable form is taken as a type for all the elaborations that have been made to avoid work and to secure a new method.

PSYCHOTHERAPY

SOME POINTS IN THE PRACTICE OF HYPNOSIS

Dr. Tuckey, *St. Louis Medical Review*,
April 8, 1905.

In the *St. Louis Medical Review* for April 8th, Dr. Tuckey develops the value of hypnotism and suggestion as a moral and educative agent in morbid childhood. It is to be noted that his

claims have not the extravagance peculiar to some who work in this field. He views this morbid exhibition as due to certain fundamental psychological defects, usually the result of defective heredity.

His suggestion is directed towards developing a normal control, a wider association of those factors which govern, rather than the mere erasal of the tendency by bare, direct suggestion. He

details four cases of kleptomania cured by him.

In his statements as to dipsomania and chronic alcoholism he is likewise calm. He cures only 40 per cent., but in this no difference is made between dipsomania and alcoholism in the tables.

Neurasthenia he views as readily improvable by hypnosis. This point, about which there is considerable difference, is, unfortunately, not developed. Here deep hypnosis is advised wherever possible, after the manner of Wetterstrand, who keeps his cases of this type in a quiet sleep for weeks.

The extreme brevity of the paper has not added to its value.

DEVICE FOR REINFORCING HYPNOSIS

Dr. Dubois, *Revue de L'Hypnotisme*, Paris, April, 1905.

In the *Revue de L'Hypnotisme* for April, Dr. Dubois notes the use of a species of vibrator attached to the head. The purpose is to produce that state of distraction most favorable to hypnosis. Its action is described as resting upon a vibration of the cerebrum. However potential cerebral sensation may be, the vibrator must have a considerable effect by limiting the attention, hence the consciousness, by its persistent, rapid, and monotonous touch sensation. Reinforcing results for successful hypnosis are definitely claimed.

HYPNOTIC SUGGESTION IN THE CURE OF THE DRINK HABIT

Dr. Berillon, *Rev. de L'Hypnotisme*, Paris, April, 1905.

In the same journal Dr. Berillon, anent hypnotism and suggestion in the drinker, remarks the necessity for prolonged mental training, mental gymnastics,

as it were, this being quite independent of suggestion. Here is a rational note of advice. Suggestion cannot reform absolutely *de novo*. There must be the accessory development of those qualities, by rigid training, which make for a higher and firmer personal synthesis. He further advocates the social support among themselves of those who are striving for a similar end of abstinence.

MENTAL ONANISM AND ITS TREATMENT

Dr. Berillon, *Rev. de L'Hypnotisme*, Paris, April, 1905.

Mental onanism, a self-explanatory term, Berillon considers as a most vicious fatigue factor in psychasthenia and neurasthenia. It is difficult to educe from the patient, but if acknowledged lends itself readily to relief by hypnosis. As a symptom it is often concealed and most tenacious, because of its intimate relation to an underlying psychopathic state.

A STUDY IN PRECOCITY AND PREMATURITY

C. L. Terman, *American Journal of Psychiatry*, April 5, 1905.

The fundamentals of this paper exist in the definition of the conditions producing precocity and prematuration. The former he conceives as racial and individual, or, in other words, as a normal variation liable to occur in the history of the race or the individual. The latter, prematuration, is the artificial production of precocity, man's hand usurping the place of nature's.

The conditions viewed as productive of prematurity are recited the more clearly by reason of the illustration of real precocity drawn from history under the several heads of Religion and Pre-

cocity, Nervousness and Instability and Precocity, etc.

This is, of course, a review of familiar material, but in his latter sections, upon the conditions producing that precocity defined as prematurity, there is much that is both new and valuable. The medical man will find that many unuttered thoughts of his own are here crystallized; thoughts that have arisen from observing the victims of our over-schooling, over-training, over-culture.

It shows the point of departure of cer-

tain psychoses in the unstable period of adolescence. Especially does it review the meaning of and the conditions favorable for sexual precocity. The effect of climatic environment, the relation to seasons, the imitative factors seen in family and school, the specific excitation, the result of over-feeding and over-culture, are determinants developed by the author.

The article is fertile in its suggestiveness rather than in its supply of specific detail.

BOOK REVIEWS

STUDIES IN GENERAL PHYSIOLOGY. By Jacques Loeb. In two volumes, pp. 1-782. University of Chicago Press, 1905. \$7.50 net.

Published under the above title and bound in a very attractive form is a collection of the numerous articles contributed by Professor Loeb to the domain of general physiology.

Although there is contained in the papers a wide diversity of topics, from "Instinct and Will in Animals" to "The Limits of Divisibility of Matter," yet a single idea runs through the entire list, and that idea is "to get the life-phenomena under our control." Particularly interesting and instructive reading are the papers dealing with the direction of motion of different animals, and the experiments on heteromorphosis.

Wide interest has been manifested in the results obtained by Loeb in his attempts to produce larvæ artificially from the unfertilized eggs of various animals. These papers, together with those on the physiological effects of ions shows the originality and breadth of view of the investigator. While one may not perhaps agree with all the conclusions drawn from the experimental data, yet one is forced to admit that the investigations

of Loeb have been an impetus to the study of this class of life phenomena which has been productive of an immense collection of valuable data.

The rendering into English of the original scattered papers will make the work accessible to all, and this fact alone would be excuse enough for the republishing of the articles were any apology necessary.

BEARD'S TREATISE ON NERVOUS EXHAUSTION (NEURASTHENIA).

Edited and enlarged by A. D. Rockwell, A.M., M.D., Neurologist and Electrotherapist to the Flushing Hospital; Formerly Professor of Electrotherapeutics in the New York Post-Graduate School; Ex-Electrotherapist to the Woman's Hospital in the State of New York, etc. Treat & Co., New York, N. Y.

Many works and innumerable articles upon neurasthenia have been written since the first appearance of this treatise—in every sense a classic—but all that has been written fails to modify in essentials, or improve upon the picture of the disease so ably delineated by the acute and original mind that first formulated its symptoms. With his keen

powers of analysis, Dr. Beard was active in formulating the thousand and one symptoms constantly detailed by the victims of what were then vaguely classed as general debility, hypochondriasis, or hysteria, and gave to them, as it were, a "local habitation and a name."

To him, more than to any other, is due the credit of having first described, under the caption "Neurasthenia," a congeries of symptoms, which has greatly simplified the treatment of such cases, and ought to do much towards the relief of a large class of suffering humanity. For all the various editions following the first, Dr. Rockwell, his former associate, has been responsible. The additions to the present edition consist mainly of a chapter on the neuron theory in its relation to treatment, based on the hypothesis that if the theory be true it will necessitate a radical revision of the physiology of nervous activity, and if it is not true, that it still remains a good working hypothesis.

The work of Apathy, Nissl, and others has thrown grave doubts upon the correctness of this theory; nevertheless it is interesting and instructive to see the clinical and theoretical aspects of the subject correlated in the discussion of the relation of electricity to this morbid condition. The fact that in the consideration of the treatment of this affection, electricity as well as drugs is given a prominent place, will render the work especially interesting to those devoted to electro-therapeutics.

DICTIONARY OF NEW MEDICAL TERMS. By George M. Gould, A.M., M.D. P. Blakiston's Son & Co., 1012 Walnut St., Philadelphia, Pa.

A considerable cause of much of the acrimonious controversy characterizing discussions upon many medical subjects is failure of the participants to comprehend just what each means. While it is

a fact that many medical scientists can express themselves accurately, vividly, and beautifully, it is also true that the great majority have not a command of language sufficient to admit of such diction, and the interchange of thought which constitutes the acquisition and dissemination of knowledge is often hampered thereby.

The enormous multiplication of medical terms during the last ten years (this work contains 38,000 words), has intensified these difficulties, and Dr. Gould has conferred a priceless service upon the profession by reducing the philological chaos to order. That the task has been accomplished in the masterly manner which one would expect from this author is evident upon even a cursory examination. A very helpful feature, especially to those of us whose graduations are some years behind us, is the section upon the abbreviations, prefixes, and suffixes used in medicine and chemistry. The sections which treat of the "Stains" used in bacteriological and pathological examinations, and the "Tests" for detection of various chemical substances are particularly complete, lucid, and satisfactory. This work will be of the greatest value to anyone who desires thoroughly to comprehend and appreciate current medical literature, and we heartily endorse it.

RADIOTHERAPY AND PHOTOTHERAPY. Including Radium and High-Frequency Currents, Their Medical and Surgical Applications in Diagnosis and Treatment. By Charles Warrene Allen, M.D., Professor of Dermatology in the New York Post-Graduate Medical School; Consulting Dermatologist to the Randall's Island Hospitals; Consulting Genito-Urinary Surgeon to the City Hospital; Member of the American Medical Association, the American Dermatological Association, the New York Dermatological Society, etc. With the Coöperation of Milton Franklin, M.D., Lecturer on Electro-Radiotherapy, New

York Polyclinic Medical School, and Samuel Stern, M.D., Radiotherapist to Dr. Lustgarten's Clinic at the Mount Sinai Hospital; Clinical Assistant to the Skin Department of the New York Post-Graduate Medical School.

Dr. Allen's book is unique in one important respect, viz., that it deals in a very exhaustive manner with the current literature upon these subjects, especially that dealing with the X-ray. Too much of a tendency has been present in most of the other books upon the X-ray, to confine the matter to an expression of the author's own individual experiences and opinions; Dr. Allen has stated the experiences and opinions of others whereby he has presented to his reader a much broader view of the field and enabled him to form judgments of his own. This is particularly desirable when a subject as youthful as X-ray therapy is being presented. Another important feature in Dr. Allen's work is that he has endeavored to establish the reliability of the reports of other observers by personal investigation before committing the statement to print.

Radiography has been treated but slightly because of the fact that several books are already available upon this subject, and the object of the present one has been principally the presentation of the therapeutical side. In the dermatological sphere, furthermore, the therapeutical measures discussed have not been confined exclusively to the X-ray and Dr. Allen's extensive experience, both as dermatologist and radiotherapist, causes these sections to be particularly valuable. Neither the X-ray nor any other one agent will accomplish what it will when combined with others; a point which many enthusiastic X-ray men seem to have overlooked.

The chapters upon "Measures of Dosage," and the "Medico-Legal Aspects of the X-ray" will be found of much value as describing the legal as-

pects of injuries inflicted upon patients, a matter which bids fair to be of considerable importance in the future.

Actinotherapy or phototherapy is accorded about 125 pages in which the subject is treated very thoroughly but succinctly. The various radio-active substances which have been discovered and used are also treated succinctly and their various possibilities as ascertained up to the present time are laid down.

High-frequency currents constitute Section 7 and are only accorded about 48 pages, but the matter has been handled in such a way as to cover the field most acceptably.

We believe Dr. Allen's book to be one of the best expositions of these subjects which has yet been published.

PRACTICAL APPLICATION OF ROENTGEN RAYS IN THERAPEUTICS AND DIAGNOSIS. By William Allen Pusey, A.M., M.D., Professor of Dermatology in the University of Illinois, and Eugene W. Caldwell, B.S., Director of the Edward N. Gibbs Memorial X-Ray Laboratory of the University and Bellevue Hospital Medical College, New York. Second edition, thoroughly revised and enlarged. Handsome octavo volume of 690 pages, with 195 illustrations, including four colored plates. Philadelphia, New York, London: W. B. Saunders & Co., 1904. Cloth, \$5.00 net; sheep or half morocco, \$6.00 net.

While divided by its authors into two separate parts, this work is in reality two separate works, part one, by Dr. Caldwell, being entirely devoted to the consideration of apparatus and manipulation, while part two, by Dr. Pusey, deals exclusively with the clinical side of the subject.

The chapters on apparatus leave almost nothing to be desired. They are very complete and the descriptions are unusually clear. The subject of coil vs.

static machine is considered in a perfectly fair way, and the usual personal prejudice is not apparent.

As compared with the other chapters that on radiography is disappointing, and one leaves it with the wish that Dr. Caldwell had said a little more. It is weak if one measures it by the following chapters on localization and plate development, which latter are most excellent.

In part two the action of the X-ray is considered, and cumulative action proven by statistical evidence. So also is the question of idiosyncrasy. In detail are given the reasons for thinking its action upon tumors similar to the action of light upon the sensitized plate, *i. e.*, chemical. Bactericidal action is discussed in full, and the production and treatment of X-ray "burns" are well considered. Coils *vs.* static machine is again discussed, and the technique of some of the more prominent workers in the X-ray field is given very clearly.

The remainder of the book (nearly one-half) is devoted to the different conditions to which the X-ray is applicable. Each in turn is taken up, references made to similar cases reported by other workers, and a very complete bibliography is appended. The author's own cases are presented, with histories and excellent photographs. These histories are the only redundant part of the work, and might well be omitted in view of the profuse presentation of such in the medical journals. The results of these accumulated reports are then summed up and a prognosis presented based upon them.

The volume is well printed and the illustrations are fair. It is a book which deserves a large sale among that large body of physicians who are not doing X-ray work, but wish to know what they may expect from it in some particular case, before they take that case to an X-ray consultant. To these the book is a valuable one, for it tells what has been

done, what is being done, and what may be expected in all the different conditions which have come under X-ray treatment.

MEXICAN VISTAS. By Harriott Wight Sherratt. Rand, McNally & Co., Chicago and New York.

By no means the least of the elements which combine to produce good results in climato-therapy is the impression upon the psychic processes due to change of scene, habits, etc. If the patient knows beforehand that these changes will be of an agreeable character, and something as to their actual nature, he will not only be less apt to procrastinate a necessary departure from his home, but will assume a frame of mind which will be conducive to the greater effectiveness of the step.

The climatic conditions prevailing in various parts of Mexico, have not been exploited from a therapeutical point of view as much as those of some other parts of the continent. Physicians who have practiced there for several years, however, tell us that they are unsurpassed, and perhaps unequaled in many respects, by those attainable anywhere else in the world, and that cases, of tuberculosis at least, do much better there than in any other resorts. In many respects the conditions in Mexico are certainly much more agreeable for the patient than at most other places recommended, and Mrs. Sherratt's little book presents an attractive picture to one who is tired of the cold, hurry, and bustle of our rigorous northern states. Her descriptions carry with them a force imparted by personal contact with the people and conditions of our sister republic and the illustrations are numerous and well selected. The volume will be of much value to those intending to travel in Mexico.

Special Plates Illustrating
Softening of, and Tumor in,
the Brain, Vesical Calculus,
and Delayed Ossification
of Epiphyses

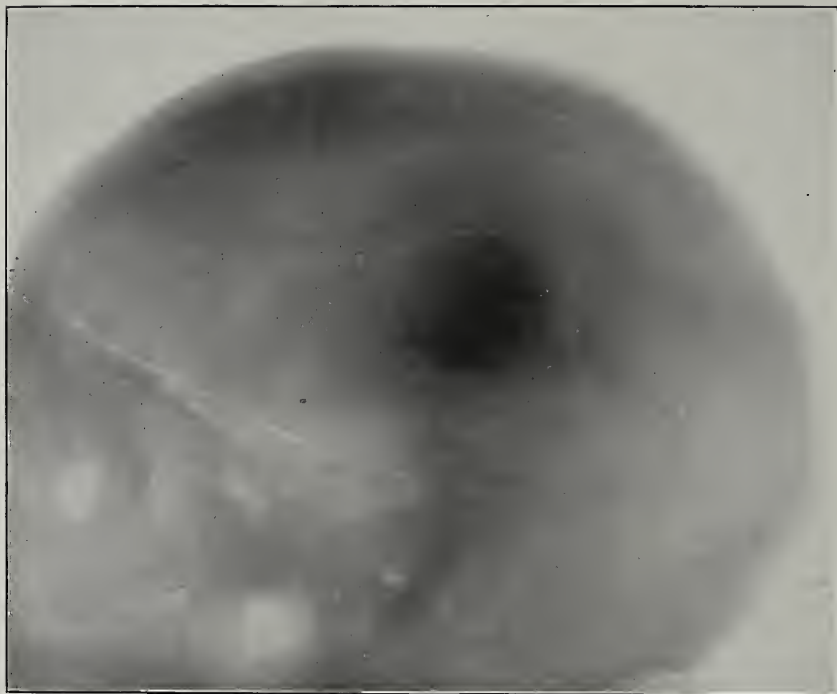




This skiagraph, made post-mortem after brain and all tissues had been replaced, shows the outline of the skull, the frontal sinuses, the orbits, the bones of the skull, the middle meningeal artery, the division between the cerebrum and the cerebellum, and the convolutions of the cerebellum. The light area in the cerebrum corresponds exactly to an area of softening.

15-inch coil, medium hard tube at 18 inches distance from plate, exposure three and one-half minutes.

By Dr. G. E. Pfahler, of Philadelphia, Pennsylvania.



Experimental skiagraph on cadaver. Tumor in motor area, the fissure of Rolando passing through the middle, above the cadaver. Tumor was inserted into the brain tissue and all tissues replaced. Skiagraph shows as follows:

Dense shadow of tumor, with clear space surrounding it indicating that the tumor, when replaced, did not fit its space exactly and that there was an absence of brain tissue surrounding it; fronto-parietal suture, parieto-occipital suture, middle meningeal artery, outline of base of skull, etc.

By Dr. G. E. Pfahler, of Philadelphia, Pennsylvania.

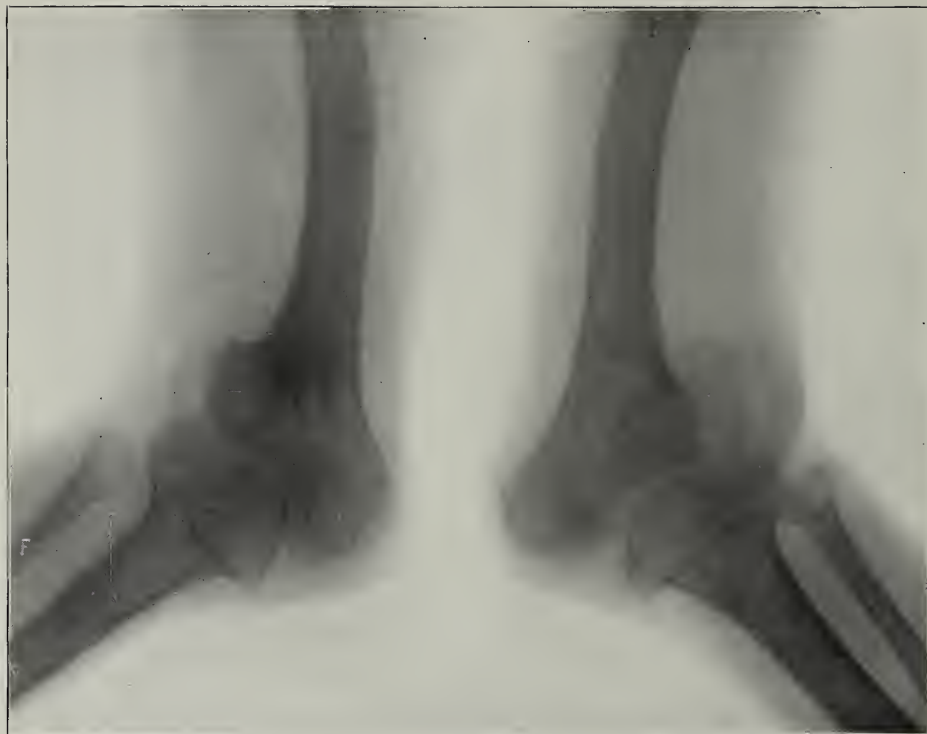


Patient 45 years of age, had suffered for 6 years, diagnosis enlarged prostate.

Skiagraph shows a four-ounce phosphatic vesical calculus; outline of bladder wall visible on the right side due to the falling of the shadow on the lighter field.

Posterior view: dorsal decubitus; tube 20 inches from plate over median line at the level of the third lumbar vertebra; exposure two minutes.

By Dr. M. K. Kassabian, of Philadelphia, Pennsylvania.



Delayed Ossification of the Epiphyses.

Patient 55 years of age. Every bone deformed. Unable to walk since childhood and had been in the hospital more than 30 years.

No history of syphilis, and Dr. Burr of the Philadelphia Hospital believes the deformities to be congenital and due to disease of the spinal cord which developed during fetal life.

The epiphyseal ends of the femora, tibiae, and fibulae look spongy from lack of ossification. Articular surfaces irregular, bones bent and pervious to the rays. The epiphyseal lines appeared darker because of excessive ossification.

By Dr. M. K. Kassabian, of Philadelphia, Pennsylvania.

THE ARCHIVES OF PHYSIOLOGICAL THERAPY

Devoted to the Diagnostic and Therapeutic Uses of Electricity, Radiant Energy, Heat, Water, Mechanical Vibration, Dietary Regulation, Exercise, Psychic Suggestion, etc.

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NUMBER FIVE

IS THE GULF STREAM A CLIMATIC MYTH?

BY JAMES KING CROOK, A.M., M.D., OF NEW YORK CITY

SINCE the appearance in 1855 of "Maury's Physical Geography of the Sea," the belief in the climatic influence of the gulf stream or Florida Current, has been practically universal. The high position held by Maury in the scientific world, his thorough acquaintance with the current theories as well as with the current knowledge of the day, and withal the entire harmony of his views regarding the origin, course, and ultimate effects of this great oceanic stream, with fully observed climatic phenomena speedily stamped his statements with something like hydrographic orthodoxy.

In accordance with Maury's teachings the gulf stream may be likened to a mighty oceanic river of 3,000 times the volume of the Mississippi, having its origin in the tropics and bearing its vast burden of warm waters northward and eastward to the great basin of the North Atlantic. Here the *vis a tergo* is supplemented by the prevailing westerly winds and the warm current, or at least its warming influence, is continued to the

shores of the British Isles and northwest continental Europe, while lands in the latitude of Labrador and South Greenland are made to smile with a luxuriant vegetation, and to give support to a dense population, under climatic conditions favorable to the highest degree of physical and intellectual development.

The fact of the existence of a gulf stream is denied by none. This is clearly proved by the northerly drift of floating objects on its surface, by the appearance of a well-marked ripple under favorable conditions showing the line of demarkation from adjoining waters, and by the sharp thermometric variations observed even within a ship's length along its margins.

On the other side of the Atlantic proof of a tempering oceanic influence is shown by the constant excess of the marine over the atmospheric temperature range along the coasts. During the winter months the ocean water averages 6.2° F. warmer than the air along the western coast of Scotland, and this excess rises to 14.5° F. at Fonholm near

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the North Cape. Another point of first significance is the fact that while the summer isotherms cross the British Isles nearly east and west, the temperature diminishing quite regularly from north to south, the winter isotherms traverse them nearly north and south, the temperature diminishing from west to east, while in Iceland the isotherms seem to envelop the island in their folds, the temperature increasing from the center to the seaboard. The little sea-girt Isle of Man with practically a marine climate, has the most equable temperature of all the British Archipelago. So in Norway the isothermal lines run parallel to the coast both in summer and winter, the temperature falling in winter and rising in summer with the increase of distance from the sea. With these facts should also be considered the entire absence of ice from Norway, even as far north as Hammerfest, throughout the winter. The dependence of the mild winter climate of the northwest coast of Europe upon the proximity of a sea which is warmer than the air, would seem to be conclusively proven.

The theory that the gulf stream is responsible for this desirable condition is today taught to millions of school children in England and the United States. The beneficent effects of this current are emphasized by the advocates of various summer watering places in northwestern Europe, and some of our own enterprising seaside resort managers are not averse to calling to attention the advantageous nearness of the gulf stream to their own demesnes. As emphasizing this general sentiment of the potency of the gulf stream, it may be recalled that during our little Venezuelan embroglio with England a few years since, one visionary patriot proposed to dam the Florida Straits through which the current passes, in order to freeze the Brit-
ishers into a proper acquiescence with our views of the questions then at issue.

Even the most recent standard scien-

tific works attach the full force of Maury's views to the gulf stream. Its influence is prominently referred to by Lally in his "Hand Book of Medical Climatology (1897)," as well as by F. Parkes Weber in Cohen's "Physiologic Therapeutics (1903)." Dr Julius Hann, the learned editor of the *Meteorologische Zeitschrift* and Professor of Cosmical Physics in the University of Vienna, in the recent edition of his "Handbuch der Climatologie" accepts without question the commonly-taught views as to the functions of this current. A translation of this work is used as a textbook at Harvard University.

There have not been lacking, however, opponents to the prevailing ideas concerning the climatic potency of this oceanic stream. Not a few eminent British and American hydrographers have doubted the efficiency of the gulf stream to bring about such striking climatic effects, basing their opinion on various considerations; that its warming influences would be lost long before the current could possibly reach the distant shores of Europe; that no other agency than that of the southwest winds is responsible and that those winds gain no heat from the water, etc.

On the other hand the theory of Lentz of St. Petersburg announced in 1845, and independently amplified and elaborated by Carpenter in 1868-70, admits the paramount importance of oceanic currents on the climates of contiguous shores, but attributes these currents to the action of a general oceanic circulation. This circulation furnishes its most striking manifestation in a poleward afflux of the upper aqueous stratum from equatorial regions, to take the place of the continual afflux of a lower cold stratum from the poles toward the equator. This circulation thus involves a continual indraught of the warm surface water from the tropics toward the poles. This indraught becomes more marked in the northern than in the south-

ern Atlantic on account of the progressive narrowing of the former, whereas the latter widens out.

There would appear to be an additional group of meteorologists who deny *in toto* the influence of oceanic currents of any kind in affecting modifications of climate. J. Knott (Medical Press and Circular, Vol. 4414 n. s. p. 79, September, 1905) under the caption of the "Gulf Stream Myth and Sea-Side Resorts," states that the fact is well known to a few meteorologists that the complete disappearance of the gulf stream and all the ocean currents in the Atlantic would not have the slightest influence on the weather and climate of Europe, provided the aerial currents remain as they are, for it is the air currents, and these alone, which are concerned in the production of climate. According to Knott the mild climate of western Europe is due to the distribution of the permanent aerial circulation prevailing over the whole Atlantic basin, with its moderating and mitigating effects, to the contiguous shores of Europe.

Maury knew nothing of this great atmospheric phenomenon, but its laws are very simple and are now fully understood. The general aerial circulation is determined by the expansion of the heated air in the tropical regions which causes it to ascend and flow north and south from the Equator toward the colder climates, and the consequent lower or surface current which flows in the opposite direction in order to restore the equilibrium. The permanent trade-winds represent the resultant motion derived from the composition of these two factors. Then the formation of a focus of low barometric pressure in high latitudes causes an inflow which leads to the production of an aerial whirlpool, known as a cyclone, while the existence in the mid parallels of an area of high

pressure causes a spiral outflow toward all points of the circumference involved, the latter condition of the atmosphere being known as an anti-cyclone.

Let us now note that in the temperate zone the atmospheric drift is from the west, which means that all coasts and countries that lie eastward of oceans possess climates ameliorated by oceanic influence, while the eastern parts of large bodies of land have climates affected by the masses of earth surface over which the aerial current has traveled. The great Mid-Atlantic anti-cyclone practically covers the Mid-Atlantic basin, the pressure increases in summer and diminishes in winter and the necessary movement to the north and east determines the fortunate climatic conditions of the British Isles and the neighboring coasts. The views at present held regarding the origin and general distribution of aerial currents are correctly stated by Knott, but it is not possible to agree with all the conclusions he deduces therefrom. The cold waters of the north Atlantic are warmed by intermingling with those of the tropics, which are impelled northward by the trade-winds; the supernal air receives a part of the heat and, with the surface water, is driven eastward.

That is all there is in the theory of the gulf stream. Possibly the functions of the stream have been exaggerated; possibly there is a vertical oceanic circulation in certain parts of the sea, and that the interior heat of the earth is transmitted to the surface; possibly also, there are other warm poleward oceanic currents in the north Atlantic; if so they are still undiscovered. In the present state of our knowledge it seems proper to hold fast to the gulf stream as at least a most important factor in the production of the climatic conditions prevailing in northwestern Europe.

REPORT OF THE COMMITTEE ON CURRENT CLASSIFICATION AND NOMENCLATURE *

LYNN, MASS., Sept. 15, 1904.
*Chairman of the Executive Committee,
American Electro-Therapeutic Association:*

DEAR SIR — I have read the report of Prof. Sheldon, as a member of the Committee on Current Classification and Nomenclature, detailing supplemental tests on electrostatic generators suitable for the use of physicians and surgeons. I have also read the statement made by Messrs. Jenks and Clarke, giving deductions, illustrations, and suggestions based upon the laboratory researches of Prof. Sheldon and others.

Without having had opportunity to personally verify the calculations of Prof. Sheldon, I understand that Mr.

Clarke has done so, and I believe that the entire report deserves the careful study and confidence of all who are interested in the results secured.

It gives me pleasure, as President of the International Electrical Congress, to note the interest which has brought about the joint session of Section H of the Congress, and the Association under the auspices of which the work of this committee has been carried on. This work is in a largely untrodden field and will, I believe, become classical in the record of exploration which will, I am persuaded, be carried forward with vigor during the next few years.

Yours very truly,
ELIHU THOMSON.

FURTHER EXPERIMENTS WITH ELECTROSTATIC MACHINES †

BY SAMUEL SHELDON

LEFFICIENCY. In the last annual report of the work of this committee in describing its tests for efficiency (ratio of output to input) mention was made of the unreliability of the needle-point gap method of measuring the voltages of Holtz and other electrostatic machines because of changes in the character of the discharges. This

unreliability has been further proven by experiment during the past year. To determine the efficiency of some of the machines submitted to the committee for test, the following method was employed:

Taking two machines, whose unknown efficiencies were represented by x and y , respectively, the second machine, whose efficiency was y , was operated as a motor, being supplied with current from the first machine, which operated as a generator. The mechanical output of the second machine was smaller than the mechanical input to the first machine, because no machine can have an efficiency of 100 per cent. In fact, the mechanical energy output of the motor equaled xy

**Read before the American Electro-Therapeutic Association, at St. Louis, Mo., September 15, 1904, and published in this journal by special permission of the Committee and the Executive Council of the Association.*

†See Second Report of the Committee on Current Classification and Nomenclature, September, 1903.

times the input of the mechanical energy supplied to the generator.*

The method of determining the mechanical input was the same as that followed and reported by this committee

*For example, assuming the input to be 300 units of mechanical energy, the efficiency x to be 50 per cent., and the efficiency y to be 40 per cent., then the output will be 50-100 of 40-100 (equal to 20-100) times 300, or 60 units of energy; that is, the mechanical energy recovered from the motor will be 20 per cent. of the mechanical energy expended in driving the generator.

last year. The mechanical output was measured by an absorption dynamometer, consisting of a brass wire with vertical spring balances fastened to each of its ends. The wire was caused to exert a retarding force upon the periphery of the pulley of the second machine, and the amount of this force could be varied by adjusting the tension of the balances.

Let p equal the difference in pounds between the pulls upon the two balances; r equal the radius of the pulley in feet; n equal the speed in revolutions per minute; then, according to the well-known

DIRECT CURRENT MOTOR				ABSORPTION-DYNAMOMETER READINGS.			HOLTZ GEN.	HOLTZ MOTOR		OUTPUT INPUT = OUTPUT $\div \frac{E}{2}$
E	I	E I	RPM	p' oz.	p'' oz.	$p'-p''=p$ oz.		R.P.M.	WATTS OUTPUT	
49.5	2.63	130.1	240	0	0.00	0.00	WAITE & BARTLETT as GENERATOR VAN HOUTEN & TEN BPIK as MOTOR	160	175	$\left. \begin{array}{l} 0.00587 \\ 0.01577 \\ 0.02304 \\ 0.03082 \\ 0.04914 \\ 0.06260 \\ 0.07560 \\ 0.07778 \\ 0.08050 \\ 0.08380 \end{array} \right\} XY$
49.0	2.71	132.7	235	2	1.00	1.00		150	170	
48.0	2.75	132.0	228	4	1.25	2.75		148	165	
48.0	2.80	134.4	225	6	1.50	4.50		145	150	
47.5	2.84	134.9	200	8	1.75	6.25		138	145	
45.5	2.83	128.7	185	12	2.00	10.00		114	138	
44.5	2.88	128.1	170	20	3.50	16.50		100	106	
42.0	2.92	122.6	160	28	4.50	23.50		88	86	
41.0	2.90	118.9	150	34	6.00	28.00		76	72	
42.0	3.00	126.0	145	40	6.50	33.50		76	66	
42.0	3.02	126.8	140	46	7.38	38.62		66	60	
47.0	2.48	116.5	270	0	0.00	0.00	McINTOSH as GENERATOR VAN H & T. B. as MOTOR	285	245	$\left. \begin{array}{l} 0.0623 \\ 0.1107 \\ 0.1446 \\ 0.1777 \\ 0.1704 \\ 0.1616 \\ 0.1265 \end{array} \right\} XZ$
48.5	2.53	122.7	270	9	1.75	7.25		275	230	
49.0	2.53	123.9	265	17	2.75	14.25		275	210	
48.5	2.51	121.7	270	27	3.75	23.25		275	165	
49.0	2.45	120.0	270	35	5.00	30.00		295	155	
50.0	2.43	121.5	270	43	6.00	37.00		295	122	
50.0	2.35	117.5	280	52	7.00	45.00		305	92	
53.0	2.28	120.8	315	62	8.25	53.75		350	62	
43.0	1.98	85.14	260	0	0.00	0.00	McI. as GEN. W. & B. as M.	300	26	$\left. \begin{array}{l} 0.00516 \\ 0.00553 \\ 0.00664 \end{array} \right\} YZ$
43.5	1.98	86.13	270	6	2.50	3.50		305	22	
44.0	1.99	87.55	255	9	3.75	5.25		300	16	
43.0	1.98	85.14	260	11	4.00	7.00		300	14	
49.5	2.88	142.5	253	0	0.00	0.00	W. & B. as GEN. McI. as MOTOR.	165	305	$\left. \begin{array}{l} 0.0667 \\ 0.0933 \\ 0.0884 \\ 0.0718 \end{array} \right\} ZY = YZ$
46.0	2.93	134.7	205	14	2.50	11.50		122	220	
45.0	3.05	137.2	190	26	3.75	22.25		112	162	
43.5	3.05	132.6	180	34	4.50	29.50		96	112	
44.0	3.13	137.6	170	45	5.25	39.75		82	70	

TABLE A (See page 214)

formula, the mechanical output in watts is

$$\frac{2\pi r n p}{33000} \times 746 = 0.142 r n p$$

If a third machine of unknown efficiency z be run as a motor with current supplied by the first machine (having an efficiency x), then the output equals xz times the input. If again, this third machine be operated as a motor by current supplied from the second machine (having an efficiency y), its output will be yz times the input.

Representing the inputs in the three cases by P_1 , P_2 , and P_3 , respectively, and the corresponding outputs by P^I , P^{II} , and P^{III} , then the following relations exist:

$$\begin{aligned} P^I &= xy P_1 \\ P^{II} &= xz P_2 \\ P^{III} &= yz P_3 \end{aligned}$$

Tests of this character were made upon the three following machines:

I. A Van Houten & Ten Broeck Holtz machine with 12 revolving 32-inch plates.

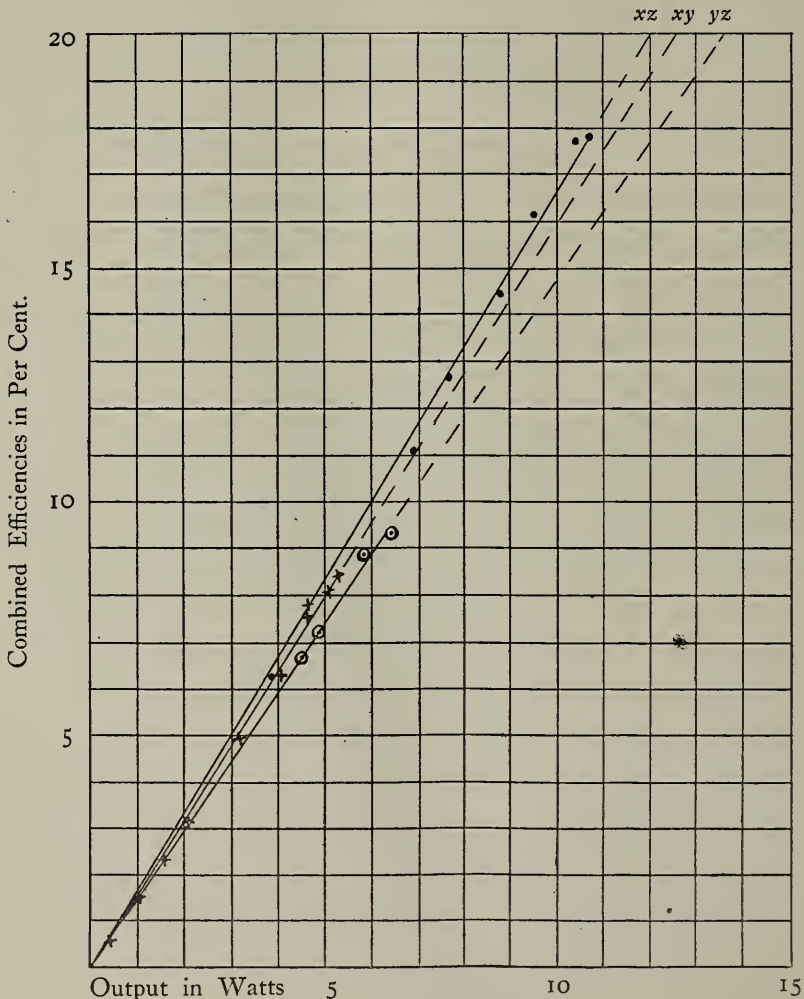


Figure 1 (See page 216)

II. A Waite & Bartlett Holtz machine with 12 revolving 30-inch plates.

III. A machine offered for test by the McIntosh Battery and Optical Company of Chicago, of the Toepler-Holtz type, having 8 revolving 30-inch plates.

The experimental data are contained in Table A.

The diameters of the pulleys of the three machines were 6.2, 7.8, and 4.8 inches, respectively.

The efficiency of the direct current

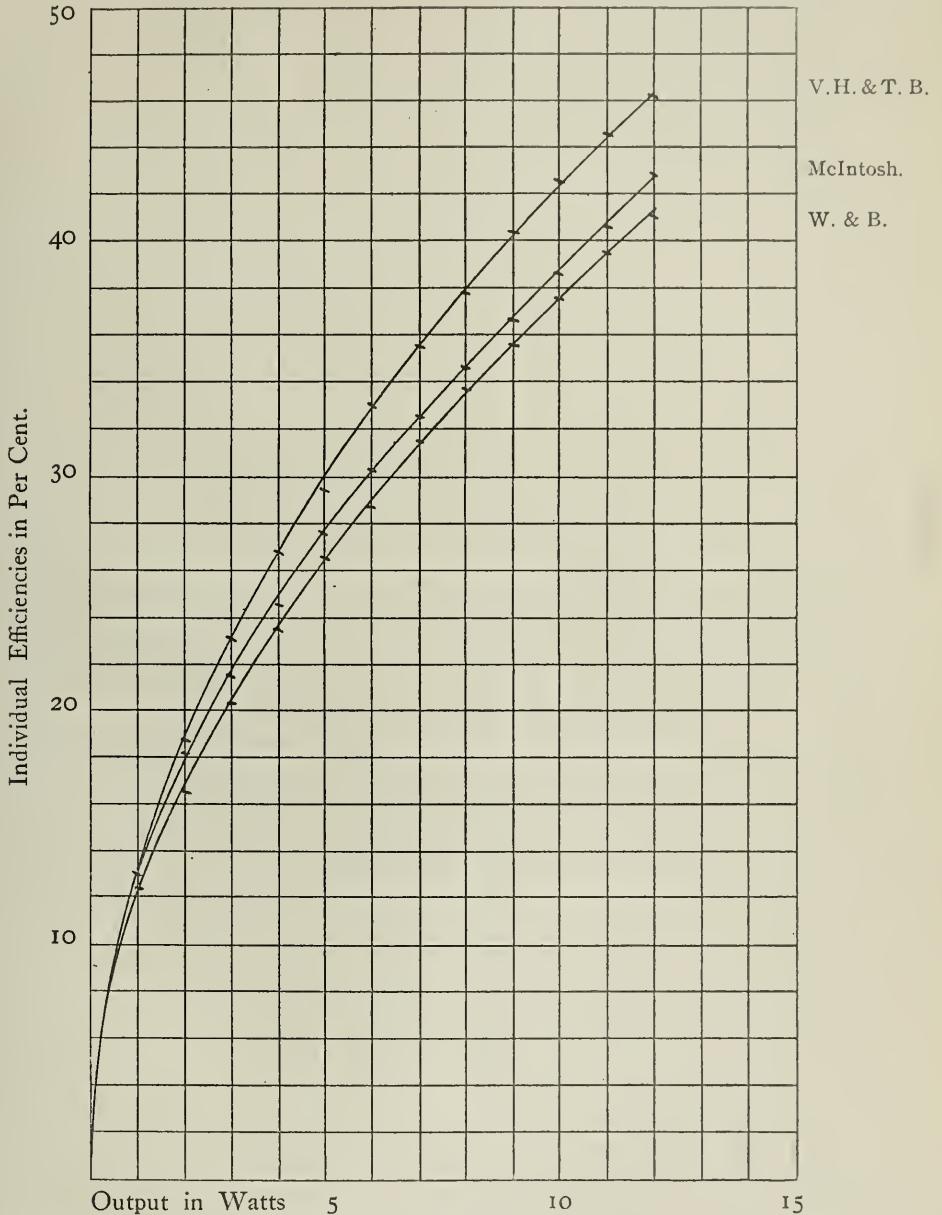


Figure 2 (See page 216)

motor, which was employed to drive one of the electrostatic machines as a generator (in the manner described last year) was such that the mechanical input to the generator in each case may be taken as 50 per cent., that is, one-half of the electrical input to the direct, current motor armature, as given in the above table.

In Fig. 1, the values of xy , xz , and yz are plotted as ordinates, and the mechanical outputs as abscissæ. Their relations are practically rectilinear.

The efficiencies of the individual machines for any given output can be determined from the values of the three efficiency products xy , xz , and yz , respectively.

For example, at a certain output let

$$\begin{aligned} xy &= a, \\ xz &= b, \\ yz &= c; \end{aligned}$$

$$\text{then } z = \frac{\sqrt{abc}}{a}; y = \frac{\sqrt{abc}}{b}; x = \frac{\sqrt{abc}}{c}.$$

Output in Watts.	Efficiencies in Per Cent.		
	Walte & Bartlett.	Van Houten & Ten Broeck.	McIntosh.
1	12.3	13.0	13.0
2	16.5	18.7	18.1
3	20.3	23.1	21.6
4	23.6	26.7	24.5
5	26.4	29.4	27.5
6	28.7	33.0	30.3
7	31.4	35.4	32.5
8	33.7	37.8	34.6
9	35.4	40.3	36.7
10	37.6	42.5	38.6
11	39.4	44.4	40.6
12	41.0	46.2	42.8

TABLE B

The efficiencies of the three machines at various electrostatic motor loads are

given in Table B, and are graphically shown in the curves of Fig. 2.

When making these tests the machines were connected with each other by brass rods of large diameter, terminating at both ends in brass balls. There was no hissing due to leakage, and the operating voltages did not rise to very high values, as was evident from the absence of sparking between the discharge balls, although they were not over an inch apart.

The physician should not confuse the combined efficiency of a pair of machines, one operating as a generator to furnish current to drive the other as a motor (as given in the tests before referred) with the individual efficiency of each machine. It is only with the individual efficiency that he is usually concerned. As an illustration: if the efficiency of one machine be 50 per cent., and that of the other machine be 40 per cent., the combined efficiency will be 50-100 times 40-100, equal to 20 per cent. But the physician is only concerned with the fact that the efficiency of one machine, when used alone as a generator, is 50 per cent., and that of the other, also when used as a generator, is 40 per cent.; and it is immaterial to him that when used together they have the much smaller combined efficiency of 20 per cent.

The losses are due to friction in the bearings, to the churning of the air by the revolving plates, and to current leakage when the machines are operated at high voltages.

The results of the tests show that commercial electrostatic machines have a much higher efficiency than has been generally supposed, and that, from the standpoint of the physician, the question of the relative efficiencies of the machines tested as above need not be considered. As will be seen from Table B, each of these machines has an efficiency of over 40 per cent.

2. CURRENT OUTPUT.

A large number of measurements have been made of the current produced by

several different machines under various conditions, including the three machines already specified, and in addition a 16-plate machine, specially manufactured for Dr. Titus of New York, by the Greenpoint Metallic Manufacturing Company; and a high-speed machine with 2 revolving mica plates, submitted for test by R. V. Wagner & Company of Chicago.

These measurements demonstrated the following conditions governing the strength of the current which is generated by disk machines of the Holtz or the Toepler-Holtz type, when they are properly excited and operated:

1. The current strength is directly proportional to the speed of rotation of the plates.

2. It is directly proportional to the length of the collecting combs.

3. It is directly proportional to the distance of the centers of the collecting combs from the axis of rotation of the plates.

4. It is directly proportional to the number of rotating plates.

Let n = number of rotating plates;

l = length of one collecting comb, in centimeters;

r = distance of center of collecting comb from the axis of rotation of the plates, in centimeters;

v = speed of rotation of the plates, in revolutions per minute;

I = strength of the current generated by the machine, in amperes.

Then

$$I = \alpha V n l r 10^{-11},$$

in which α is a constant, and 10^{-11} is the multiplying factor for obtaining the value of the current I in amperes. For all practical purposes α may be taken as equal to 57, and the equation then takes the final form

$$I = 57 V n l r 10^{-11}.$$

In Table C are given the observed values of the generated currents, the current strengths calculated by means of the above formula, and the data employed in the calculation.

The speed of the Wagner machine could not be measured directly, because the character of the bearings would not permit the use of a tachometer. The speed given in the table was obtained from the speed of the driving motor referred to in Table A, due allowance having been made for belt slippage.

Name of Machine,	V.	n.	l.	r.	l.	l.
					Calculated.	Observed.
McIntosh,	400	8	11.90	28.4	0.000 616	0.000 649
Waite & Bartlett,	380	10	10.06	31.0	0.000 712	0.000 725
Wagner,	1,305	2	12.10	32.1	0.000 576	0.000 540
		{ 5	6.86	46.0 }	0.000 495	0.000 533
		{ 3	13.72	41.3 }		
Titus,	265	{ 5	6.86	46.0 }	0.000 839	0.000 872
		{ 7	13.72	41.3 }		
		{ 5	6.86	46.0 }	0.001 180	0.001 042
		{ 11	13.72	41.3 }		
Van Houten & Ten Broeck,	340	12	14.09	33.7	0.001 090	0.000 968

TABLE C

The machine of Dr. Titus had 16 rotating plates, and by means of a mechanical device either four or eight of these plates could be loosened from the axle and prevented from rotating by a brake bearing upon their lower edges. The design necessitated projections from the axle between certain of the disks, and at these places the collecting combs were shortened so as to prevent sparking to the axle. This shortening has been taken into account in the calculations.

The above approximate formula applies to machines when working in a satisfactory manner, a condition which is readily recognized by those who are practically familiar with their normal operation. When machines are about to lose their charge, or are operating improperly, the current will be less than the amount indicated by the formula.

With a given machine operating in normal condition the current which is being generated is dependent solely upon the speed. Thus the McIntosh machine yielded 16-100 milliamperes at 100 revolutions per minute, twice that amount for double the speed, and so on. Hence, to determine the current which is being generated, one needs only to measure the speed, and multiply by the proper constant.

It should be noted that the strength of the current which is generated, and may be closely derived from the formula, and is indicated when the machine is short-circuited through an ammeter, seldom or never corresponds with the strength that is utilized by the physician, either in a patient or in apparatus. The inevitable leakage of current both within and outside the machine, the amount of which will vary greatly with the conditions of operation, materially reduces the percentage of the generated current which is utilized. On the other hand, currents resulting from oscillatory and from high frequency discharges may have a value enormously greater than the current generated, due either to storage ca-

capacity, as by the use of condensers, or to transformer action, as by induction coils.

3. CURRENT CHARACTERISTICS. The physician is probably more interested in ascertaining the qualitative characteristics of the current derived from an electrostatic machine, and particularly whether it be a direct or an alternating current, than in determining quantitatively its physical constants; as, for example, in the case of an alternating current, the exact frequency or wave shape.

In any given circuit the character of the current which will result from a sudden electrical disturbance, such as arises from the discharge of a Leyden jar, is dependent upon three factors; namely, the inductance, resistance, and capacity of the circuit.

If the inductance, in henrys, be represented by L ; the resistance, in ohms, by R ; and the capacity, in farads, by C , then the current will be oscillatory, provided $\frac{1}{LC}$ be greater than $\frac{R^2}{4L^2}$

If $\frac{1}{LC}$ be equal to or less than $\frac{R^2}{4L^2}$ the current will be unidirectional.

If the current be oscillatory, the frequency f of the oscillations, in cycles per second, will be

$$f = 0.159155 \sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}}$$

To obtain with close accuracy the values of the three physical constants, L , R , and C of such circuits as are met with in the physician's work is practically impossible in the present state of knowledge, but methods of determining approximately such values, sufficiently accurate for his purposes, are given below.

4. INDUCTANCE. The inductance of a circuit is independent of its resistance, and depends only upon its geometrical shape, and upon the presence or absence of magnetic substances, and particularly iron.

Many circuits in the physician's work

consist essentially of a single loop in the shape of a skewed and bent rectangle, the sides of which are made up of discharge knobs, rods, chains, connecting cords, and portions of a patient's body, as for example, one arm and the leg on the same side of the body.

The inductance of such a circuit can, of course, only be approximately calculated; the approximation, however, is sufficient for the physician's purposes. At very high frequencies the inductance in henrys, of a circuit consisting of a single conducting loop l cms. long, and d cms. in diameter, is expressed by the formula *

$$L = 2l \left\{ \log_e \frac{4l}{d} - a \right\} 10^{-9},$$

in which a is equal to 2.5 for a circular or square loop.

If a be made unity, the equation gives the inductance of a straight wire of length l cms., and diameter d cms.; if the loop be rectangular in shape, a will have a larger value than 2.5.

Changes in the diameter of the conductor do not materially affect the value of the inductance. For, consider two square-loop circuits, each one meter long on a side, the first being made up of a cylindrical conductor of the diameter of a discharge rod, say 1 cm., and the second of a diameter of 10 cms., say that of a man's arm. The first circuit will then have a self-inductance of about 0.000004 henry, and the second a self-inductance of about 0.000002 henry. Although the cross-section of the conductor in one case is a hundred times as large as in the other, the inductance is reduced only one-half.

It is immaterial to the physician what the value of the significant figure of the numeric is, so long as he knows that the inductance is of the order of a millionth of a henry.

When a circuit is composed of more than one loop or turn, as in the case of a coiled wire, the self-inductance of a single turn is to be calculated by the above formula, and the result multiplied by the square of the number of turns. The product will be too large, owing to magnetic leakage; but this will not alter the order of magnitude of the result obtained. Half the product will be an approximately correct value to assume in the case of coils wound with their turns fairly close to one other.

The inductance for high frequencies is somewhat different from that for low frequencies; but in such cases the difference is immaterial.

5. RESISTANCE. The resistance which is offered by an ordinary solid cylindrical conductor, such as a metal wire or rod, to currents of very high frequency of the order of a million, or more, per second, is greater than that which is offered to direct, or low frequency alternating currents. This is due to the fact that self-inductance causes the major part of a high frequency current to flow through the outer portion, or skin, as it were, of the conductor, and permits the current to sink into the conductor to only a slight extent. Hence, the conductor, though solid, behaves towards such currents practically as though it were a hollow cylinder; and the conducting cross-section being thus reduced, the practical result is an increase of the resistance.

If R_1 = resistance, in ohms, per centimeter length of a conductor for constant currents or alternating currents of ordinary low frequencies;

f = frequency of a high-frequency current in cycles per second;

l = length of the conductor, in cms.

μ = average permeability of the substance of which the conductor is made (for iron = 900; for ordinary substances = unity);

then the total resistance of the conductor,

*Fleming's "Handbook for the Electrical Laboratory," vol. ii, pp. 173-175.

in ohms, to the high-frequency current will be *

$$R = 0.000056 l \sqrt{f \mu R_1}$$

As an example of the influence of high frequency in increasing the resistance, it may be stated that the resistance of a No. 10 B. & S. copper wire is ten times as great for currents of frequencies of a million per second as for constant, or low frequency alternating, currents. With wires of larger diameter the increase of resistance will be still greater.

In many circuits employed by physicians the major portion of the resistance resides in a spark gap, and the magnitude of the resistance of this gap is in some cases the controlling factor in determining whether the discharge is oscillatory or not. Its value depends upon a large number of variables, among which are the length of gap, character and shape of discharge knobs, strength and duration of current, and the pressure, temperature, and humidity of the atmosphere.

The writer is not aware of any direct measurements of the resistance of a spark gap. Indirectly, however, discharges of unquestionably oscillatory character have been obtained in circuits of such known inductance and capacity that the resistance of the circuit, including a gap of over two inches between knobs $1\frac{3}{4}$ inches in diameter, must have been, according to the critical formula given heretofore, less than 100 ohms.

The apparent resistance of direct current arcs between $\frac{1}{2}$ -inch spherical brass electrodes, with a gap-length of 1-16 inch, was measured and found to be less than 12 ohms when a current of less than 12 amperes was flowing. It is believed by some authorities that a portion of this apparent resistance is due to a counter-electromotive force of thermal origin,

and that, therefore, the real resistance is smaller than the apparent resistance. The apparent resistance of an arc decreases with increase of current.

It has been observed that in the standard Cooper-Hewitt mercury vapor lamp, having a length of 4 feet and a diameter of 2.5 inches, a current of 3 amperes results from the expenditure of a potential of 20 volts per foot of length. The apparent resistance of the mercury arc in the lamp is, therefore, slightly less than 7 ohms per foot.

The maximum instantaneous value of the current which flows during a discharge between the knobs of a Holtz machine, when its jars are connected in circuit, may amount to hundreds of amperes, and doubtless frequently exceeds 100 amperes. The time during which the strength of the current is so great is, however, extremely short.

The loudness of the noise accompanying the discharge in a measure indicates the degree of condensation and rarefaction along the path of the discharge. Rarefaction and large currents conspire to reduce the gap resistance.

6. CAPACITY. The most important capacity that arises in these kinds of circuits is that of the Leyden jars. The capacities of the four standard sizes of Waite & Bartlett jars were measured by means of a ballistic galvanometer with the use of high voltages furnished by a Holtz machine. They were found to be respectively, 0.0008; 0.0004; 0.00026, and 0.00008 microfarads. A measurement of the area of the outside conducting foil showed that there was an approximate capacity of a millionth of a microfarad per square centimeter of outside coating.

In general, the capacity of a condenser of this character, as also of the plate form, is expressed by the following formula:

$$C = 0.000225 \frac{An}{t} k,$$

*Derived from the first equation on p. 245 of Lodge's "Lightning Conductors and Lightning Guards," 1892.

where C = capacity, in microfarads,
 A = area of dielectric between two
conducting plates, in square
inches,
 n = number of sheets of dielectric,
 t = thickness of dielectric in mils,
 k = specific inductive capacity of
dielectric, as obtained from
the following table:

Air	1.0
Glass	3.0 to 7.0
Hard Rubber	2.2 to 3.0
Paraffin	2.0 to 2.3
Mica	6.6
Kerosene	2.0 to 2.5

Measurements were also made of the capacity offered by a man standing upon an ordinary insulating platform, and considered as one electrode of a condenser, the other terminal of the machine being grounded so that the floor and structural iron of the building constituted the other electrode. The capacity was found to be 0.00005 microfarad. When the man stood upon a hard-rubber plate 0.25 inch thick, which was placed upon a brass plate constituting the other electrode, the capacity was increased to 0.0002 microfarad.

The capacity of the conductor and the metal parts of a machine generally need not be considered when the jars are in use.

It should be noted that when jars or other condensers are connected in series,

as is generally the case in these kinds of circuits, the resulting capacity of the circuit is reduced. If condensers of capacities C_1 , C_2 , and C_3 , be connected in series, the resulting capacity will be

$$C = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}}$$

Frequently the only capacity that need be considered is that due to 2 Leyden jars of equal size connected in series between the discharge terminals of a machine. Under such circumstances the resulting capacity is one-half that of one jar alone.

In making the measurements which form the basis of this report, the writer was most ably assisted by one of his students, Mr. Oskytel H. Clarke, and grateful acknowledgment is hereby extended.

The writer also acknowledges on behalf of the committee the cordial cooperation of the manufacturers specified in this report, in placing at his disposal the electrostatic machines described; also, the courtesy of the General Electric Company and Mr. W. S. Andrews of Schenectady, N. Y., in the loan of instruments of precision of unusual capacities for making measurements used in the preparation of the tables and curves which summarize the laboratory work herein detailed.

HIGH FREQUENCY OSCILLATORY AND PULSATORY DISCHARGES

BY W. J. JENKS AND CHAS. L. CLARKE

Résumé of the Committee's Reports.

THE present report marks the close of the third year of the existence of this committee. All of its work has been performed under considerable disadvantages, such as the stress of duties as electrical engineers outside the scope of this association and lack of adequate suggestion and coöperation on the part of the physicians who

are most interested in the results reached by the committee. As a result of these and other disadvantages the committee has not covered the ground of nomenclature as systematically and thoroughly as was at first planned.

The first report, submitted at Kaaterskill, in 1902, laid the foundation, by definition and illustration, for a clear appreciation of all the classes of currents

with which physicians and surgeons deal, and the features by which each class is distinguished; and proposed for consideration, discussion, and adoption by the Association the terminology therein given as applicable to these currents, and recognized by electrical engineers in this and other countries.

The second report, at the Atlantic City meeting, 1903, emphasized the importance of the universal adoption by electro-therapeutists of terms and forms of expression which are in accord with the units and definitions adopted by electrical engineers. It also described and illustrated by diagrams the various combinations of apparatus and circuit arrangement then commonly employed by physicians and surgeons for electrical applications from Holtz machines and similar sources of current; and explained in simple terms the effects of resistance, inductance, and capacity upon the resulting currents applied to the patient. It further announced the results of important original laboratory investigations by Prof. Samuel Sheldon of the committee, as to the principles of operation, capabilities, and efficiency of electrostatic generators, with details of test conditions and tables of data secured.

The third report, now submitted, contains a record of Prof. Sheldon's further laboratory researches, with considerable detail of results obtained from five electrostatic machines of large capacity, which were submitted by the manufacturers as the latest forms of commercial machines made by them.

EFFICIENCY OF ELECTROSTATIC MACHINES

Although known to electrical engineers for some years, it may not have been heretofore known to some of the members of the association that a Holtz machine can be used as a motor as well as a generator; and it is very gratifying to the committee to be able to demonstrate that when a Holtz machine is used as a

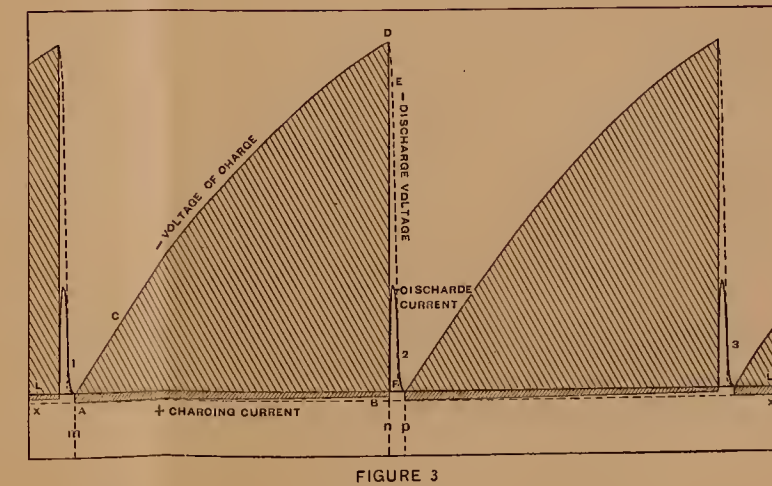
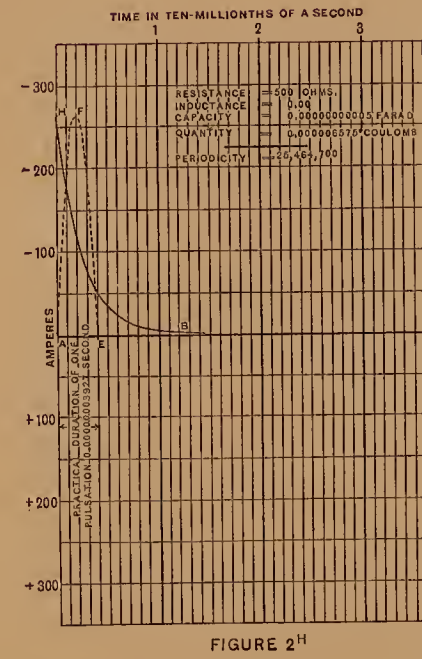
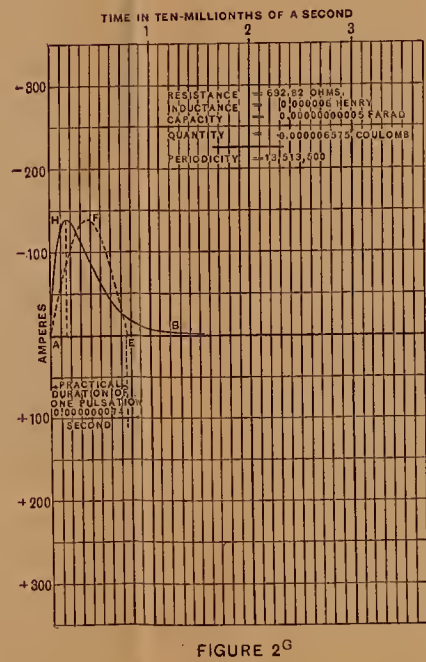
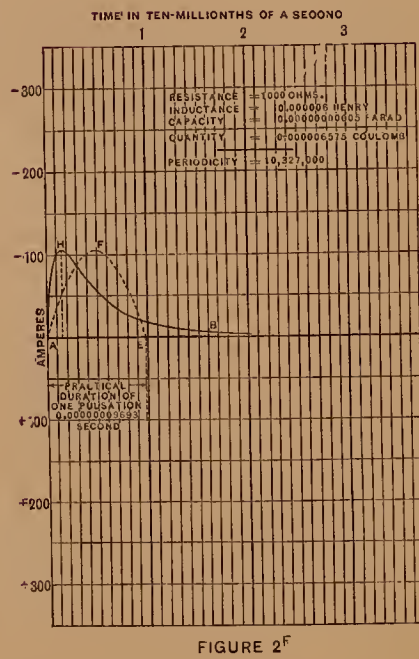
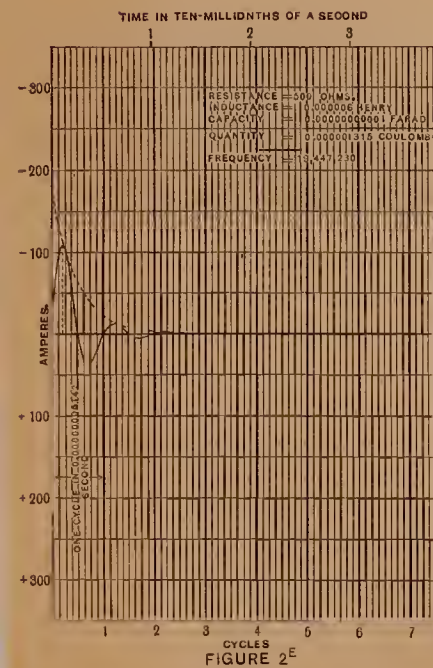
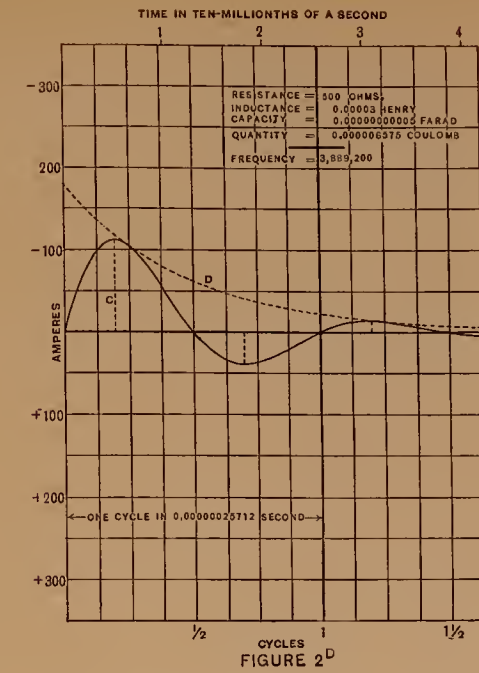
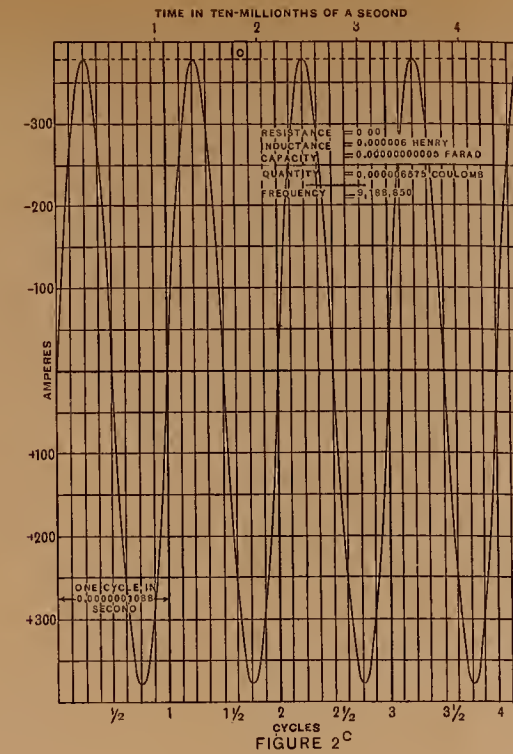
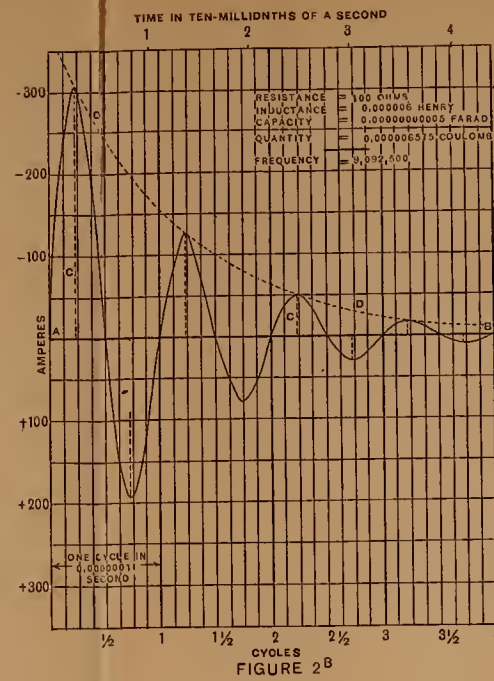
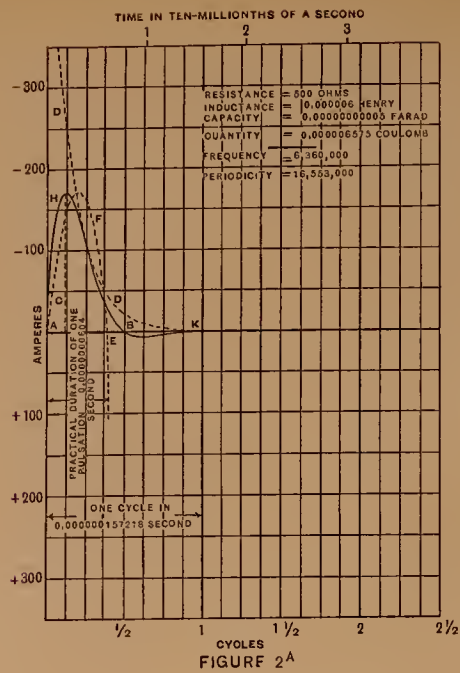
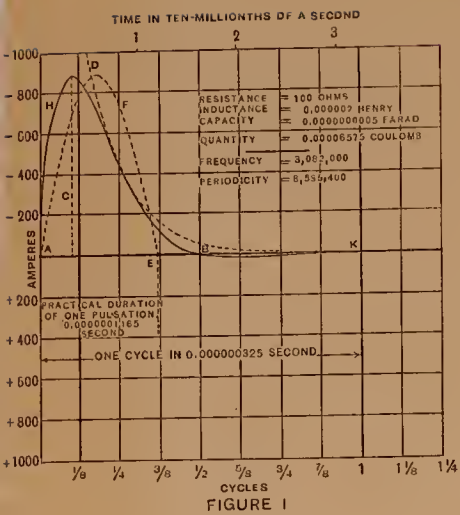
motor, its efficiency may be as high as when used as a generator, and has been found, by Prof. Sheldon's tests, to be greater than 40 per cent. in the cases of the three machines which were received by him in time to be subjected to tests of this character. It is to be regretted that the Wagner and Titus machines were not available when the motor-generator efficiency experiments were made.

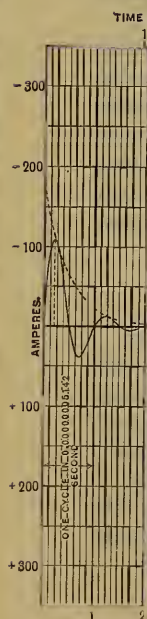
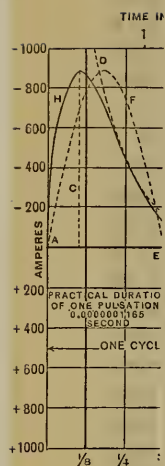
It is beyond the province of your committee to attempt many comments, such as a comparison of the features of these five machines, included in Table C of Prof. Sheldon's report, will suggest to the practical reader.

But it is deemed proper to call attention to the great difference in speed at which some of the machines were operated. From the figures of Table C the speed of the points in the two plates of the Wagner machine opposite the centers of the collecting combs was approximately 8,600 feet per minute; and the speed of the points in the eight plates of the McIntosh machine opposite the centers of its collecting combs (which were practically of the same length as those of the Wagner machine) was approximately 2,300 feet per minute.

This is a comparison which is important to the physician because the apparent mechanical disadvantage of the high peripheral speed of the Wagner plates (about 2 miles a minute) must be set over against the apparent disadvantage of requiring, in the McIntosh form, as an example of low-speed construction, six additional revolving plates to produce about 20 per cent. more current.

It is the same question that has been repeatedly raised in the manufacture of dynamo-electric generators during the past twenty-five years — the proper mean between the highest output per unit of material and the greatest reliability and safety of operation. Time will determine to what extent the substitution of other material in place of glass for the revolving plates, coupled with great in-





crease of speed, can cheapen the cost of production and maintenance. The principle and general method of operation are the same in all.

As electrostatic machines are now designed, the question of their absolute or relative efficiency is of minor consequence where power is cheap, and becomes an important matter only when the machine is driven by hand.

In view of the demonstration disclosed by Prof. Sheldon's tests of an individual efficiency of nearly 50 per cent. for existing static machines, and the fact, so far as this committee is informed, that the laws governing their proper design have not heretofore been formulated in any publication, makers of such apparatus should be stimulated to improve upon the present design of their product with the idea of making future machines of greatly increased available potential and current capacity without correspondingly increasing either their complexity and cost, or reducing their efficiency.

CIRCUIT CONDITIONS NECESSARY FOR THE PRODUCTION OF OSCILLATORY CURRENTS

From such discussions as we have secured by special appointment, we have been led to understand that the most urgent need of the members of this association is accurate information in the following particulars regarding high-frequency alternating currents:

(a) as to the conditions under which they are present;

(b) as to the manner of most effectively and certainly obtaining them; and,

(c) as to the conditions under which they may be expected to change into low-frequency or even into unidirectional currents, possibly without betraying to the operator the fact that such changes or any changes in the character of the current have taken place.

The circuit conditions which give rise

to oscillatory discharges from a Leyden jar or other form of condenser have been tersely summarized by Prof. Sheldon in his statement of experiments which forms part of this report. In plain terms, the current will be oscillatory provided the quotient of unity divided by the product of the inductance and capacity or condensance of the circuit, is greater than the quotient of the square of the resistance divided by four times the square of the inductance. If the three factors, inductance, capacity, and resistance, are known, the determination of the frequency by the formula given by Prof. Sheldon is a mere matter of simple arithmetic.

Let us then write out in words and figures that symbolic formula:

Current is oscillatory when

$$\frac{1}{\text{inductance} \times \text{capacity}}$$

is greater than

$$\frac{\text{Resistance}^2}{4 \text{ Inductance}^2}$$

Hence, to secure an oscillatory current, the general relations of the three factors to one another may be expressed as follows:

Resistance must be small;

Capacity must be small;

Inductance must be large.

As an illustration, let us assume a case in which the possible values of these three factors of inductance, capacity, and resistance are such as have been mentioned by Prof. Sheldon.

From the data given in his paper as to the inductance of a square loop one meter on a side, we may assume in the case of an arrangement for administering the Morton "wave current," as illustrated in Fig. F of this committee's report of last year, and forming a loop, say, two meters on a side, an inductance of 0.000006 henry.

From his statements as to capacity of a condenser formed of the patient on an

insulating platform as one plate, and the floor and walls as the other plate, we may assume for it a capacity of 0.00005 microfarad, or 0.0000000005 farad, the capacity of the other conductors of the circuit being assumed negligible.

From his figures as to the resistance of a 2-inch spark gap between knobs while the spark is passing, we may also assume that fraction of the total resistance as 100 ohms. His statements do not include any estimate of the resistance of the human body, but we may assume the resistance of the patient between properly moistened electrodes of large surface, to be, say, 400 ohms, which raises the total resistance of the circuit to practically 500 ohms.

Then substituting the above assumed values in the formula given by Prof. Sheldon, we have

$$f = 0.159155 \sqrt{\frac{1}{0.000006 \times 0.0000000005 - \frac{500^2}{4 \times 0.000006^2}}}$$

from which $f=6,360,000$.

That is to say, the frequency of the current under the conditions just assumed will be more than 6,000,000 per second.

Inasmuch as the current is produced by a charge in a circuit that is left to itself, and unaffected by outside influences, and the frequency is therefore determined solely by the capacity, inductance, and resistance, that is, by the electrical characteristics of the circuit, the frequency under such circumstances is known as the *natural* frequency of the circuit.

Now further assuming that the resistance of the patient is increased to 900 ohms, all the other conditions remaining as before, and therefore that the total circuit resistance is 1,000 ohms, we have

$$f = 0.159155 \sqrt{\frac{1}{0.000006 \times 0.0000000005 - \frac{1000^2}{4 \times 0.000006^2}}}$$

The second term under the radical being greater than the first term, the whole quantity under the radical is negative, and therefore the equation is imaginary and impossible of solution, and the frequency cannot be determined therefrom. Physically interpreted, this condition means that the current will not be oscillatory, but will be unidirectional in character, the oscillations existing when the patient's resistance was 400 ohms having been damped out by the increase of that resistance to 900 ohms.

It is obvious that other values for the inductance and capacity than those above assumed in the last equation might be chosen, that would likewise cause the first term under the radical to be less than the second term, and thus cause the whole quantity under the radical to be negative, and demonstrate the non-oscillatory character of the current under such conditions.

On the other hand, the inductance, or capacity, or both, might be assumed to be changed to such values as would give a very high frequency in the solution of the equation, and with the resistance still remaining at 1,000 ohms.

All the conditions thus assumed may be realized in practice.

STRENGTH OF CURRENT OBTAINABLE FROM ORDINARY LEYDEN JARS

Prof. Sheldon has stated in his paper that the maximum instantaneous value of the current which flows during a discharge between the knobs of a Holtz machine, when its jars are connected in circuit, may amount to hundreds of amperes, and doubtless frequently exceeds 100 amperes, although the time during which the strength of the current is so great is extremely short. These are

facts that may be new to many physicians, and certainly are important for them to fully appreciate. A specific illustration will not only prove interesting, but lead up to consideration of other important characteristics of such a current, and also serve as a more or less complete answer to some of the matters hereinbefore considered.

As such a specific case, let the inside coatings of two jars be connected with a Holtz machine, one coating with each prime conductor, and let the outside coatings be connected with each other by a conductor of adjustable resistance, substantially as in the arrangement of apparatus for administering the Morton "static-induced" current, described (and illustrated in Fig. C) in the committee's report of last year. Let each jar have a capacity of 0.001 microfarad, which is y greater capacity than that given by Prof. Sheldon for the largest standard jar furnished with the Waite & Bartlett machine. Being connected in series the combined total capacity of the two jars will be 0.0005 microfarad, or 0.000000005 farad. It may be assumed with practical accuracy that there is no other capacity in the circuit.

Assume further that the inductance of the circuit is 0.000002 henry. This assumption is entirely warranted by the calculations of Prof. Sheldon, who has found that the inductance of a square-shaped circuit, consisting of a conductor one centimeter in diameter and one meter long on a side, is 0.000004 henry, and with a similar conductor ten centimeters in diameter, is 0.000002 henry. It is evident that by a suitable arrangement of the circuit, as to shape, length, and diameter of the conductor, the assumed inductance of 0.000002 henry can be obtained.

Let it also be assumed that the resistance of the circuit is 100 ohms, which, of course, must include the resistance of the spark gap during the discharge and flow of current. This assumption is warrant-

able in view of Prof. Sheldon's observation in a particular case that, under a high-frequency oscillatory discharge, the total resistance of a circuit, including a spark gap of over two inches, was less than 100 ohms. By adding to the resistance of the metallic part of the circuit the total resistance could be adjusted to substantially the 100 ohms assumed.

Assume also that the discharge knobs are each $1\frac{1}{2}$ inches in diameter and their adjacent surfaces 2 inches apart. The mean effective potential difference then required to produce a discharge between the knobs is practically the same as that which will start a discharge between needle-points about $8\frac{3}{4}$ inches apart, namely, 93,000 volts, which, multiplied by 1.414, gives 131,500 for the maximum instantaneous voltage. (See the committee's report for 1903, Sheldon's Experiments with Holtz Machines, Figs. 4 and 6, and Table of Sparking Distances.)

It is well within the capability of a Holtz machine to furnish a current from the combs to the prime conductors of 1 milliamperes when the discharge knobs are in contact, and a current of $\frac{1}{2}$ milliamperes to the Leyden jars, connected with the prime conductors, when the knobs are 2 inches apart, in spite of the leakages which then necessarily take place. (Compare column of amperes, output of Holtz machine, as given in Fig. 3 of Prof. Sheldon's paper in the committee's report for last year, with the column of observed amperes in Table C of his paper in the present report.)

Assume, then, that the machine is delivering a constant current of $\frac{1}{2}$ milliamperes to the jars. The time T , in seconds, required to charge the jars to the volts V necessary to produce a discharge between the knobs, is equal to the quotient obtained by dividing the product of the volts V , and capacity C , in farads, by the current A , in amperes; or

$$T = \frac{VC}{A}$$

Substituting the above values for voltage, capacity and current in the formula, we have

$$T = \frac{131,500 \times 0.000000005}{0.0005} = 0.1315 \text{ second.}$$

That is, the jars will be charged to the discharging voltage in 0.1315 second. From this it follows that with the machine in continuous operation, discharges will take place between the knobs at the rate of 7.6 times per second.

Now the quantity of electricity $VC = Q$, in coulombs, that flows into the jars between two successive discharges is also equal to the product of the current by the time it flows or

$$Q = AT.$$

That is, in this case, $Q = 0.0005 \times 0.1315 = 0.0006575$ coulomb.

We have, therefore, for the values of the several constants of the circuit, as assumed in the foregoing case:

$$\begin{aligned} \text{Capacity, } C &= 0.000000005 \text{ farad;} \\ \text{Inductance, } L &= 0.000002 \text{ henry;} \\ \text{Resistance, } R &= 100.0 \text{ ohms;} \\ \text{Quantity, } Q &= 0.0006575 \text{ coulomb.} \end{aligned}$$

The first characteristic of the current to be determined is its frequency f , the equation for which is

$$(1)$$

$$f = \frac{\sqrt{4LC - R^2C^2}}{4\pi LC} = 0.159155 \sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}}.$$

By substituting the numerical value of the constants in this equation we have

$$f = 0.159155 \sqrt{\frac{1}{0.000002 \times 0.000000005} - \frac{100^2}{4 \times 0.000002^2}},$$

from which $f = 3,082,000$ cycles or complete oscillations of the current per second.

The reciprocal of f gives the duration of a cycle or time in which a complete oscillation takes place, which in this case is equal to 0.000000325 second.

In other words the current oscillates at the rate of over three millions cycles per second, and makes one oscillation in less than the one three-millionth part of a second. This does not mean that oscillations are *maintained* at that rate. As will be seen later, the duration of the oscillations resulting from a single spark discharge until they have practically died out is extremely short, the current of each discharge practically lasting for considerably less than one-millionth of a second.

We have next to determine the strengths of the current at different instants of time after the discharge of the jars between the knobs and flow of current in the circuit have begun, from which instantaneous strengths a curve showing the characteristic shape of the current waves may be plotted.

The equation for determining the strength i , in amperes, of the current at any time t , in seconds, after the flow of the discharge current has begun, is

$$i = -\frac{2Q}{\sqrt{4LC - R^2C^2}} e^{-\frac{Rt}{2L}} \sin \left\{ \frac{\sqrt{4LC - R^2C^2}}{2LC} t \right\}, \quad (2)$$

in which e is the base of Naperian, natural or hyperbolic logarithms, which equals 2.71828.

$$\text{Recollecting that } \frac{\sqrt{4LC - R^2C^2}}{4\pi LC} = f,$$

by substitution equation (2) may be written in the more convenient form

$$i = -\frac{Q}{2\pi f LC} e^{-\frac{Rt}{2L}} \sin (2\pi f t). \quad (3)$$

Now substituting the foregoing numerical values in equation (3), we have

$$i = -\frac{0.0006575}{2 \times 3.1416 \times 3,082,000 \times 0.000002 \times 0.000}$$

$$\frac{100t}{2 \times 0.000002} \sin(2 \times 3.1416 \times 3,082,000t),$$

which reduces to

$$i = -3,395.308e^{-25,000,000t} \sin(19,365,000t).$$

From the last equation the strengths of the current given in the following table have been calculated for the fractions of a cycle completed, and the corresponding instants of time, after the discharge current has begun to flow; to which are added the *greatest maximum* strength of the current, and the time required for it to attain its greatest maximum, as hereafter derived from equations (4) and (5).

Cycles.	Time t in fractions of a second.	Instantaneous values i of current in amperes.
0	0.000	0.0
1/16	0.0000000203125	— 782.3
	0.0000000340900	— 886.7 ^{greatest max.}
1/8	0.0000000406250	— 869.9
1/4	0.0000000812500	— 445.6
3/8	0.0000001218750	— 114.3
1/2	0.0000001625000	0.0
5/8	0.0000002031250	+ 15.0
3/4	0.0000002437500	+ 7.67
7/8	0.0000002843750	+ 1.97
1	0.0000003250000	0.0

It is important to know the greatest maximum instantaneous value of the current, and the time taken (always in the first half-cycle) to attain its greatest maximum strength after the current has begun to flow.

The general equation for the maximum instantaneous value of the current in any half-cycle is

$$i_{\max.} = \pm \frac{Q}{\sqrt{LC}} e^{-\frac{R}{4\pi fL} \tan^{-1} \frac{4\pi fL}{R}}, \quad (4)$$

which is — for odd half-cycles, and + for even half-cycles, commencing with zero time.

The current attains its *greatest maximum* value in the first half-cycle. Substituting the numerical values of the con-

stants in the last equation, we have — 886.7 amperes as the greatest maximum instantaneous value of the current. The maximum current during the second half-cycle is + 15.3 amperes.

The expression for the time, in seconds, required for the current to attain its maximum strength in any half-cycle is

$$t_{\max.} = \frac{1}{2\pi f} \tan^{-1} \frac{4\pi fL}{R} \quad (5)$$

from which we obtain 0.00000003409 second as the time at which the current arrives at its greatest maximum value of — 886.7 amperes. And for each half-cycle the current arrives at its maximum strength for that cycle in the same time after the beginning of the half-cycle. Since the duration of a complete cycle is 0.000000325 second, the current attains its greatest maximum value in a little less than 1/10 of a cycle. If the cycle be considered as divided into 360 degrees, the current reaches its greatest maximum value 37.76 degrees after it has begun to flow.

The foregoing results are illustrated, in Fig. 1, by the oscillatory current curve A H B K, in which time is measured horizontally, and the strength of the current vertically. The time at which the current attains its greatest maximum value is marked by the vertical dotted line C.

It will be seen that it is easily possible to obtain a very large current, although for an extremely short time, from the larger size of Leyden jars used with a Holtz machine; in the case just considered the current strength attains a maximum value of more than — 800 amperes.

DAMPING EFFECT OF CIRCUIT RESISTANCE

A noteworthy characteristic of the current in the case illustrated in Fig. 1 is the rapidity with which oscillations are damped down by the resistance of the

circuit. In fact the damping is so rapid that the maximum strength of the current flowing in one direction during the second half B K of the first cycle is only about two per cent. of its maximum value when flowing in the opposite direction during the first half A B of the cycle. Calculation of the current strength during the second cycle would show that the current practically dies out during the first cycle.

The damping effect of the resistance in decreasing the amplitude of the current up to any time t is represented by the curve D, which is a logarithmic curve, gradually approaching but requiring an infinite time to attain zero value, and representing the rate of damping of the current oscillations. Consequently the current theoretically also requires an infinite time to entirely die out, although it attains a practically zero value in the fraction of a millionth of a second.

The equation for the damping curve, or damping effect d , as measured in terms of the same magnitude as the amperes of the current curve, is:

$$d = -\frac{Q}{2\pi fLC} e^{-\frac{Rt}{2L}} \quad (6)$$

For the particular case illustrated in Fig. 1 the equation reduces to the form

$$d = -3,395.308e^{-25,000,000t}$$

The damping curve touches, or is tangent, to the current wave at the middle points of the odd half-cycles; if the similar but inverted curve be drawn below the zero line it will be tangent to the current curve at the middle points of the even half-cycles; and at all points the current oscillations will lie between the two curves of damping effect.

Furthermore, the *mean* value of the current strength during the second half of the first cycle is practically negligible compared with its mean value during

the first half of the cycle.

The general expression for the mean strength of the current during the n th half-cycle after the commencement of discharge is

$$i_{\text{mean, } n\text{th half-cycle}} = \pm 2fQ \left\{ e^{-\frac{nR}{4fL}} + e^{-\frac{(n-1)R}{4fL}} \right\}, \quad (7)$$

in which f is the frequency, the formula for which has been already given. The double sign \pm will be $-$ when n is an odd number, and $+$ when n is even, the $-$ sign indicating that a *discharging* current flows out of the condenser during each odd half-cycle, and the $+$ sign that a *charging* current flows into the condenser during the even half-cycles.

From the above equation, the mean strength of the discharging current during the first half-cycle ($n=1$) is

$$i_{\text{mean, 1st half-cycle}} = -2fQ \left\{ e^{-\frac{R}{4fL}} + 1 \right\}, \quad (8)$$

and its mean strength during the second half cycle ($n=2$) is

$$i_{\text{mean, 2d half-cycle}} = +2fQ \left\{ e^{-\frac{R}{2fL}} + e^{-\frac{R}{4fL}} \right\}. \quad (9)$$

By substituting the values of the constants $f=3,082,000$; $Q=0.00006575$; $R=100$; and $L=0.000002$ in the last two equations, and solving, we obtain for the mean values of the current curve, shown in Fig. 1, during the first and second half-cycles, respectively, -412 amperes, and $+7.14$ amperes.

Therefore the current may be considered as substantially a unidirectional (direct) pulsatory current, lasting for the first half-cycle, or in this case, 0.0000001625 second, upon the assumption that beyond the first half-cycle the current is relatively so small as to be practically negligible.

FREQUENCY OF OSCILLATORY CURRENTS AND PERIODICITY OF PULSATORY CURRENTS

Assuming, then, that the rapidly damped current shown in Fig. 1 is a pulsatory current, terminating at the practical ending of the pulsation at the point B, it will be seen that the current attains its maximum value considerably before half the duration of the pulsation has passed; and that its average strength for the second half of the pulsation is much less than for the first half; and further that a large proportion of the time toward the end of the pulsation is required for the small remanent current to die away; and it is obvious that by far the greater part of the total effect produced by the whole pulsation must take place before the pulsation is half completed.

The foregoing characteristics and effect of the current shown in Fig. 1 will be found true for all other oscillatory currents that are damped down so rapidly that they may be considered as practically lasting only for a time equal to half an oscillation, and, therefore, as practically pulsatory.

The same characteristics and effect of the current likewise pertain to all *true* pulsatory currents, which, although rising to a maximum and then gradually dying down to zero in an infinite length of time without oscillation, may be looked upon, nevertheless, as oscillatory currents, with the point B or time at which the first half-oscillation ends, at an infinite distance from the starting point A, or commencement of discharge, and with a zero strength of current during

the second half-oscillation below the zero line, and beyond the infinitely distant point B.

Although a true pulsatory current requires an infinite time to complete a cycle, it is, nevertheless, obvious that such a current may be properly considered as having a finite duration, or as completing a cycle in a finite time; in fact, the practical duration of a pulsatory current cycle is ordinarily for only a very small fraction of a second.

One of the important characteristics of all forms of alternating currents is their *frequency*, a term which is used in the electrical art to indicate the *rate of oscillation*, that is, the number of times the current would pass through a complete cycle in one second upon the assumption that the oscillations continue for that length of time. The reciprocal of the frequency is equal to the duration of, or time required for, one complete cycle.

But there is no analogous term generally recognized in the art as indicative of the *rate of pulsation* of a unidirectional pulsatory current, that is, the number of times such a current would pass through a *practically complete* pulsation or cycle in one second upon the assumption that the pulsations are repeated for that length of time, and that one pulsation begins as soon as the preceding pulsation has *practically* ceased.

For the purposes of this report the term *periodicity* will be so applied to true pulsatory currents, and also to oscillatory currents that are damped down so rapidly that they may be regarded as practically pulsatory, as in the case illustrated in Fig. 1.

CRITERION FOR THE DETERMINATION OF PERIODICITY

In the opinion of this committee, it is as important for the electro-therapeutist to know the *periodicity* of pulsatory currents as to know the frequency of oscil-

latory currents, for they are both expressions of the rapidity with which the currents go through a cycle, which, in respect to the frequency of assumed oscillatory currents, has been believed by many eminent physicians to have a vital bearing upon their therapeutic effects. The criterion for frequency is well known, and the mathematical rule for its calculation has been hereinbefore given. It remains to find a criterion for *periodicity*, and to give rules for its calculation applicable to true pulsatory currents, and also to those oscillatory currents that may be assumed, with practical accuracy, to be pulsatory.

Frequency relates to the rapidity with which an alternating current (of which the oscillatory discharge current from a condenser is a type) passes through a cycle or wave-like rise and fall from zero strength; flowing during the first half-cycle in one direction with a strength increasing from zero to a maximum and decreasing again to zero, and then repeating the same operation while flowing in the opposite direction during the second half-cycle; and so on for succeeding cycles.

Periodicity relates to the rapidity with which a unidirectional pulsatory current passes through a cycle which consists in a single half wave, on one side only of a line of zero strength, analogous to a single half-cycle of an alternating current. But theoretically the duration of a pulsatory cycle is infinite; that is, the rapidity with which the current passes through a cycle is really zero, and such a criterion for its periodicity should be assumed as will represent for working purposes the rapidity with which a pulsatory (single impulse) cycle is *practically* completed, in a manner analogous to the way in which frequency represents the rapidity with which an alternating (double impulse) cycle is *fully* completed.

The criterion here assumed for periodicity is the reciprocal of the time which would be required for a pulsatory

current, having the assumed form of a sine half-wave, and of the same instantaneous maximum value as the true pulsatory current, or practically pulsatory oscillatory current, to completely discharge from the condenser.

The criterion for periodicity may be perhaps more clearly stated in another way by reference to Fig. 1. Assuming that the current curve A H B K practically ends at B, draw a sine half-wave curve A F E whose maximum height is equal to the maximum height of the first half-cycle A H B of the current curve, and whose area is equal to the algebraic sum of all the current curve areas to infinity; the sine half-wave will be the *equivalent coulomb sine pulsation*; it represents the total quantity or coulombs in the condenser; the length of its base A E represents the fraction of a second of time in which this quantity would be discharged by a current represented by the curve A F E; the reciprocal of this time is the number of pulsations A F E that could occur in one second without overlapping, and without intervals between them, and this number is the *periodicity*.

RULE FOR THE CALCULATION OF PERIODICITY

Referring to Fig. 1, the time of duration $t' = A E$ of the *equivalent coulomb sine pulsation* is expressed by the formula

$$t' = \frac{\pi Q}{2M} = 1.570796 \frac{Q}{M}, \quad (10)$$

in which Q is the charge, and M the maximum instantaneous values of the equivalent coulomb sine pulsation A F E, and actual current curve A H B.

The reciprocal of t' is the expression for the periodicity p , or

$$p = 0.63662 \frac{M}{Q}. \quad (11)$$

Substituting the numerical values of the constants, for the case shown in Fig.

1, in equations (10) and (11), we obtain 0.0000001165 second for the value of t' , or the duration A E of the equivalent coulomb sine pulsation; and a periodicity p of 8,585,400.

RELATIVE DURATION OF CURRENT DISCHARGING AND CHARGING INTERVALS

On the foregoing assumption that the discharge current, in the case illustrated in Fig. 1, is practically pulsatory, a comparison of the interval of time between successive pulsations (during which the Leyden jars are being charged by the Holtz machine in continuous operation) with the duration of a pulsation will be of special interest. Since the pulsatory discharges take place once in each 0.1315 second, and a pulsation practically endures only for 0.0000001165 second, as determined by the duration of the equivalent coulomb sine pulsation the interval between the ending of one pulsation and the beginning of the next pulsation will be 0.1315 second. The duration of a pulsation is, therefore, only about the 90/1000000th of one per cent. of the time-interval between pulsations. If this ratio be expressed in terms of length, instead of time, it may be more readily comprehended. If the practical duration of a current pulsation (from A to E in Fig. 1) be represented by a length of 1 inch, the time-interval between successive pulsations (during which the jars are being charged) will be represented by a length of 92,000 feet, or 17.5 miles.

In addition to the fact that the current set up in a circuit, by the discharge of an ordinary Leyden jar, under certain circumstances may rise to a high value, *the physician is specially interested in knowing its characteristics under the practical conditions that may exist when a patient is included in the circuit.*

ILLUSTRATION OF CONDITIONS OF ORDINARY OFFICE PRACTICE

To this end, let us take an example in which the arrangement of apparatus and

patient is assumed to be the same as in the Morton "wave current" application, described in the committee's report for 1903, and illustrated in Fig. F thereof. The several constants assumed for the circuit are based upon data given by Prof. Sheldon, and are as follows:

Resistance, including, say, 100 ohms at the air-gap between the discharge knobs when the spark is passing, and also the patient, making a total assumed resistance of 500 ohms.

Capacity of the condenser formed by the patient as one plate, and by the floor and walls of the room as the other plate, 0.0000000005 farad.

Inductance due to the size and shape of the circuit in which the patient is included, 0.000006 henry.

Quantity of charge in the patient (based upon the assumptions stated in the case of Fig. 1), 0.000006575 coulomb. Discharges, therefore, will take place at the rate of 76 times per second.

Frequency, calculated by equation (1), 6,360,000 per second; and duration of one cycle, or complete oscillation, 0.000000157218 second.

Substituting the above numerical values for the constants in equations (3), (4), and (5), the following results for the instantaneous values of the current are obtained:

Cycles.	Time t in fractions of a second.	Instantaneous values i of current in amperes.
0	0.000	0.0
	0.000000019128	— 170.96 greatest max.
1/8	0.000000019652	— 170.8
1/4	0.000000039305	— 106.5
3/8	0.000000058957	— 33.23
1/2	0.000000078609	0.00
	0.000000097737	+ 6.463 second max.
5/8	0.000000098261	+ 6.463
3/4	0.000000117914	+ 4.0
7/8	0.000000137566	+ 1.273
1	0.000000157218	0.000
1-1/4	0.000000196523	— 0.15
1-1/2	0.000000235827	0.00
1-3/4	0.000000275132	+ 0.00576
2	0.000000314436	0.0

From equations (8) and (9) the

mean value of the current during the first half-cycle is -87.8 amperes, and during the second half-cycle, $+3.28$ amperes.

The greatest maximum instantaneous value of the current, from equation (4), is -170.96 amperes; and it rises to its greatest maximum in 0.00000019128 second, or in a little less than $1/8$ cycle; or in angular measure, 43.8 degrees after the current begins to flow. The maximum current in the second half-cycle is $+6.436$ amperes.

Considering the current as practically pulsatory, with a maximum strength of -170.96 amperes, from equation (10) the duration of the equivalent coulomb sine pulsation is 0.000000604 second, and from equation (11) the periodicity is $16,553,000$.

The current curve A H B K is shown in Fig. 2^A. The dotted line C indicates the time of greatest maximum strength of current. The curve D is the curve of damping effect, derived from equation (6). The sine half-wave curve A F E represents the equivalent coulomb sine pulsation, equivalent to the half-wave A H B of the current curve.

Since the duration of the equivalent coulomb sine pulsation A F E is 0.000000604 second, and the discharges between the knobs, and therefore the resulting pulsations, will occur at intervals of 0.01315 second, or 76 times per second, we find that the practical duration of a pulsation is only $460/1,000,000$ th of one per cent. of the time-interval between pulsations. In other words, if the pulsation (from A to E, in Fig. 2^A) is 1 inch in length, the interval between the ending of one pulsation and the beginning of the next pulsation would be $18,000$ feet, or more than 3 miles.

In this connection, attention is called to the fact that the resistance of 500 ohms, assumed for the circuit in the present example, would have to be increased by only a small per cent. to pre-

vent the discharging current from swinging across the zero line, as shown in Fig. 2^A, and thus changing it from a slightly oscillatory into a true pulsatory current.

Having given in the last example an illustration of the character of the current that may be present under clinical conditions, it is important to know what effect changes in the resistance, inductance, and capacity of the circuit may have upon the strength, frequency, and oscillation of the current.

CHANGES IN OSCILLATIONS RESULTING FROM CHANGES IN RESISTANCE

In the following example the effect of change in resistance alone will be considered. All the constants of the circuit and other conditions are assumed the same as in the last example, excepting that the resistance is reduced from 500 to 100 ohms, although it is not known to the committee whether or not the resistance can fall so low with a patient in circuit under clinical conditions.

The frequency is $9,092,500$, and the duration of a complete cycle is 0.00000011 second.

The calculated results for the instantaneous values of the current are as follows:

Cycles.	Time t in fractions of a second.	Instantaneous values i of current in amperes.
0	0.000	0.0
1/8	0.00000001375	-242.2
	0.00000002500	-308.2 greatest max.
1/4	0.00000002750	-304.4
3/8	0.00000004125	-192.3
1/2	0.00000005500	0.0
5/8	0.00000006875	$+152.8$
3/4	0.00000008250	$+192.8$
7/8	0.00000009625	$+121.6$
1	0.00000011000	0.0
1-1/4	0.00000013750	-122.2
1-1/2	0.00000016500	0.0
1-3/4	0.00000019250	$+77.2$
2	0.00000022000	0.0
2-1/4	0.00000024750	-48.7
2-1/2	0.00000027500	0.0
2-3/4	0.00000030250	$+30.7$
3	0.00000033000	0.0
3-1/4	0.00000035750	-19.4

Cycles.	Time t in fractions of a second.	Instantaneous values i of current in amperes.
3-1/2	0.00000038500	0.0
3-3/4	0.00000041250	+ 10.5
4	0.00000044000	0.0

The greatest maximum instantaneous value of the current is — 308.2 amperes, and the current arrives at the maximum value in 0.000000025 second, or in angular measure 81.7 degrees.

The above results are illustrated in the oscillatory current curve in Fig. 2^B, four cycles of which are shown. The vertical lines C mark the times at which the current attains its maximum value in the respective half-cycles. D is the curve of damping effect.

In consequence of the reduction in resistance from 500 to 100 ohms the frequency rises from 6,360,000 to 9,092,500 cycles per second, while the duration of a cycle falls from 0.000000157218 second to 0.00000011 second; and the greatest maximum instantaneous value of the current increases from 170.96 to 308.2 amperes.

Comparing Figs. 2^A and 2^B it will be seen from the curve of damping effect that decreasing the resistance causes a less rapid damping down of the current, so that the oscillations are prolonged, and in the particular case shown in Fig. 2^B, so greatly prolonged that the current must be treated as oscillatory, and not as practically pulsatory. With 500 ohms resistance the maximum value of the current in the second half of the first cycle is a little more than 3 per cent. of its maximum value in the first half of the cycle, while with only 100 ohms in circuit the current is not damped down to the same extent until it has made four complete oscillations.

But the duration of the four oscillations (0.00000044 second) bears only an exceedingly small ratio to the time between discharges (which take place at the rate of 76 per second) during which interval a comparatively negligible amount of current is flowing. Representing the duration of the four oscillations

(from A to B, in Fig. 2^B) as a length of 8 inches, the intervals between successive discharges, that is, between successive sets of oscillations of four cycles each, would be 19,920 feet, or nearly 4 miles.

Obviously, if the resistance, instead of being diminished from 500 ohms to 100 ohms, were increased above 500 ohms, then instead of the current increasing in strength and having its oscillations prolonged and frequency increased, as shown in Fig. 2^B when compared with Fig. 2^A, its strength and frequency would be less, and its oscillations damped down quicker than shown in Fig. 2^A. By increasing the resistance sufficiently, all oscillation would be suppressed, and the current become a true pulsatory current, gradually dying down to zero, theoretically in an infinite time.

EFFECT UPON THE OSCILLATIONS OF A CIRCUIT OF ZERO RESISTANCE

The effect of decreasing the resistance of 500 ohms, in the case shown in Fig. 2^A, to 100 ohms, having been investigated, and illustrated in Fig. 2^B, it is well to consider what would be the effect if the resistance could be decreased to zero.

An oscillatory current set up in a circuit of zero resistance by the discharge of a condenser, other conditions being equal, represents the extreme limit to which the current can theoretically attain, in respect to maximum strength, maximum frequency, minimum damping effect, and resulting maximum prolongation of the oscillations. This is an interesting case to consider as showing to the physician the importance of making every effort to reduce the resistance of the circuit, including the resistance of the patient, when it is desired to administer a rapid succession of strong physiological effects.

For a circuit of zero resistance equation (1) for frequency becomes

$$f = \frac{1}{2\pi\sqrt{LC}} = 0.159155 \frac{1}{\sqrt{LC}} \quad (12)$$

The frequency that a discharge current would have in an inductive circuit, if its resistance were zero, is called the *proper* frequency of the circuit.

The general equation (3) for current becomes

$$i = -\frac{Q}{\sqrt{LC}} \sin(2\pi ft), \quad (13)$$

which is the expression for a simple harmonic or sine wave current.

Equation (4) for the maximum strength of the current reduces to the form

$$i_{\max.} = \pm \frac{Q}{\sqrt{LC}}, \quad (14)$$

which is a constant; and therefore the maximum value of the current is the same for all cycles; that is, there is no damping effect upon the oscillations with a zero resistance, and they continue indefinitely with undiminished strength; the form of equation (13) also leads to the same conclusion. The \pm sign is — for odd half-cycles, and + for even half-cycles.

Equation (6) for the damping effect becomes a constant, and like equation (14); therefore the damping curve will be a straight line parallel to the zero line and tangent to the tops of the current waves.

Equation (5) for time of arrival of the current at maximum strength after the beginning of any half-cycle becomes, with zero resistance,

$$t_{\max. i} = \frac{1}{2\pi f} \tan^{-1}\infty, \quad (15)$$

that is, the current reaches maximum in the middle of each half-cycle.

Equation (7) for the mean value of the current takes the form

$$i_{\text{mean}} = \pm \frac{2Q}{\pi\sqrt{LC}} = \pm 0.6366 \frac{Q}{\sqrt{LC}}, \quad (16)$$

which is — for odd half-cycles, and + for even half-cycles.

Applying the equations to a case in which all the conditions are the same as in

the cases shown in Figs. 2^A and 2^B, excepting that the resistance is assumed to be reduced to zero, the frequency becomes 9,188,860, and therefore the duration of a cycle is 0.0000001088 second; the maximum instantaneous strength of the current is ± 379.6 amperes, and the mean current ± 241.7 amperes.

The current curve is shown in Fig. 2^C, in which D is the curve of zero damping rate.

CHANGES IN OSCILLATIONS RESULTING FROM CHANGES IN INDUCTANCE

Let the effect of change in inductance be next considered, which we will assume to be increased five times, or from 0.000006 henry to 0.00003 henry, the resistance still remaining unchanged at 500 ohms, the capacity at 0.0000000005 farad, and the quantity at 0.000006575 coulombs, as in the example illustrated in Fig. 2^A. The discharge knobs are assumed as still unchanged at a distance of 2 inches apart, and the Holtz machine as supplying a constant current of $\frac{1}{2}$ milliamperes to the jar, and therefore the discharge rate will continue to be 76 per second.

The frequency is 3,889,200, and the duration of a cycle is 0.00000025712 second.

The calculated results for the instantaneous values of the current are as follows:

Cycles.	Time t in fractions of a second.	Instantaneous values i of current in amperes.
0	0.000	0.0
1/16	0.00000001607	— 60.10
1/8	0.00000003214	— 97.00
3/16	0.00000004821	— 110.51
	0.00000005083	— 111.18 greatest max.
1/4	0.00000006428	— 104.96
3/8	0.00000009642	— 56.80
1/2	0.00000012856	0.0
5/8	0.00000016070	+ 33.21
3/4	0.00000019284	+ 35.95
7/8	0.00000022498	+ 19.45
1	0.00000025712	0.0
1-1/4	0.00000032140	— 12.29
1-1/2	0.00000038568	0.0

Cycles.	Time t in fractions of a second.	Instantaneous values i of current in amperes.
1-3/4	0.00000044996	+ 4.22
2	0.00000051424	0.0
2-1/4	0.00000057852	- 1.44
2-1/2	0.00000064280	0.0

The greatest maximum instantaneous strength of a current is — 111.18 amperes. It arrives at its maximum value in 0.0000005083 second, or in 71.17 degrees (about one-fifth) of a cycle.

The above results are illustrated in the oscillatory current curve in Fig. 2^D. The vertical lines C show the times of maximum current strengths. The curve D represents the damping effect of the resistance.

By the five-fold increase of the inductance from 0.000006 henry to 0.00003 henry the frequency falls from 6,360,000 to 3,889,200; the duration of a cycle is lengthened from 0.000000157218 second to 0.00000025712 second; and the greatest maximum instantaneous value of the current decreases from — 170.96 amperes to — 111.18 amperes.

A comparison of Figs. 2^A and 2^D graphically illustrates the effect of an increase of inductance in decreasing the damping rate, as shown by the less rapid slope of the damping curve in Fig. 2^D, and therefore in prolonging the oscillations; also in diminishing the maximum and mean strength of the current, and decreasing the frequency. Comparison of Figs. 2^B and 2^D shows, however, that the damping effect of increasing the inductance alone is not so great as the damping effect of reducing only the resistance to the same degree, although in the latter case a larger number of oscillations result in a given time than in the former. Diminishing the inductance would, of course, produce effects of an opposite kind to those mentioned.

EFFECT UPON THE OSCILLATIONS OF A CIRCUIT OF ZERO INDUCTANCE AND ZERO RESISTANCE

It will be interesting to ascertain what

effect upon the character of the current the inductance and resistance would have if they could simultaneously have a zero value; although, of course, it is impossible to absolutely attain to either of such conditions.

It is apparent that if these conditions could be attained the current would be oscillatory, because the condition which determines the character of a current as oscillatory, namely, that R^2C be less than $4L$, would still be true when L and R are both zero; for we would then have $R^2C = 0^2$, and $4L = 0$, and 0^2 being a zero quantity of the second order would be smaller than 0 , a zero quantity of the first order.

Therefore the general equation (3) for an oscillatory current would be applicable if the inductance and resistance were both equal to zero. But if the resistance alone were zero, equation (3) would take the form given in equation (13), and we can obtain the equation for current if the inductance were also zero by substituting zero for L in equation (13).

Making the substitution, and observing that from equation (12) the frequency would be infinite, the general equation for current takes the form $i = -\infty \sin(2\pi\infty t)$; which means that a Leyden jar discharge current, in a circuit of zero resistance and zero inductance, would be an oscillatory current of infinite frequency, and therefore with an infinitely short duration for each cycle, and would continue to oscillate indefinitely with a constant and infinitely great maximum instantaneous value.

CHANGES IN OSCILLATIONS RESULTING FROM CHANGES IN CAPACITY

To arrive at a conception of the effect of a change in the capacity of the circuit upon the character of the discharge-current wave, let the discharge knobs remain 2 inches apart and a current of $\frac{1}{2}$

milliampere be supplied to the jar from the Holtz machine, as heretofore; and let the circuit have the original resistance of 500 ohms, and inductance of 0.000006 henry, but assume its capacity to be reduced to 0.0000000001 farad, or one-fifth of its original amount. The capacity being reduced four-fifths, the jar will be charged up to the discharging pressure of 131,500 volts between the knobs by a charge one-fifth as great, or 0.000001315 coulomb, and in one-fifth the time required in the three last cases considered, and therefore the discharge rate will be five times greater than before, or 380 per second.

The frequency is 19,447,230, and the duration of a cycle is 0.00000005142 second.

The calculated instantaneous values of the current under the foregoing circuit conditions are as follows:

Cycles.	Time t in fractions of a second.	Instantaneous values i of current in amperes.
0	0.000	0.0
1/16	0.000000003214	— 60.1
1/8	0.000000006428	— 97.0
	0.000000010166	— 111.18 greatest max.
1/4	0.000000012855	— 104.96
3/8	0.000000019283	— 56.80
1/2	0.000000025710	0.0
5/8	0.000000032138	+ 33.21
3/4	0.000000038565	+ 35.95
7/8	0.000000044993	+ 19.45
1	0.000000051420	0.0
1-1/4	0.000000064275	— 12.29
1-1/2	0.000000077130	0.0
1-3/4	0.000000089985	+ 4.22
2	0.000000102840	0.0
2-1/4	0.000000115695	— 1.44
2-1/2	0.000000128550	0.0
2-3/4	0.000000141405	+ 0.495
3	0.000000154260	0.0

The greatest maximum strength of the current is — 111.18 amperes, and it arrives at its maximum value in 0.000000010166 second, or in nearly one-fifth (71.17 degrees) of a cycle.

The above results are illustrated in the oscillatory current curve in Fig. 2^E, in which the time of maximum current,

and the curve of damping rate are also shown.

By the five-fold diminution of the capacity from 0.00000000005 farad to 0.00000000001 farad (accompanied by a five-fold decrease of quantity of charge from 0.000006575 coulomb to 0.000001315 coulomb) the frequency increases from 6,360,000 to 19,446,000; the duration of a cycle is shortened from 0.000000157218 second to 0.00000005142 second; and the maximum instantaneous value of the current decreases from — 170.96 amperes to — 111.18 amperes. Increasing the capacity, on the other hand, would increase the strength of current, decrease the frequency, and prolong the oscillations.

Comparison of Figs. 2^A and 2^E shows how by diminishing the capacity, accompanied by a corresponding diminution in quantity of charge, the frequency and oscillatory effect are increased, and the duration of a cycle and the damping effect are decreased. But it is well to note here that the capacity cannot be indefinitely reduced, for the strength of a discharge current in a circuit of zero capacity would also be zero.

RELATIVE EFFECTS UPON THE OSCILLATIONS OF RESISTANCE, INDUCTANCE, AND CAPACITY

An intercomparison of Figs. 2^A to 2^E shows that if unidirectional, pulsatory discharge-currents from a jar or other condenser, charged from a Holtz machine, are the desideratum for electrotherapeutic applications in a particular case, the main factor toward their production is the resistance of the circuit, including the patient, which should be suitably high, as in the case illustrated by Fig. 2^A, in which the current is only slightly oscillatory, and practically pulsatory, and which would become strictly pulsatory by sufficiently increasing the resistance above 500 ohms.

If on the other hand prolonged oscillation of the currents is wanted, to obtain in the patient a succession of strong condenser effects, the resistance is still the main factor in the production of such currents, but in such case it has to be properly reduced in strength, as illustrated for example in Fig. 2^B.

Again, should it be desired to obtain prolonged oscillation of the current, and lengthened duration of oscillations, that is, a current of lower frequency, and therefore less sudden in change of strength, the main controlling factor in such case is the inductance of the circuit, increase in which tends to produce the above results.

Still further, if currents of prolonged oscillatory character are wanted, but with the duration of each oscillation shorter, that is, currents of higher frequency, and therefore more sudden in change of strength, the prime controlling factor in this case is the capacity of the circuit, decrease in which acts in the direction of effecting the result desired, and also to increase the rate at which successive oscillatory discharges take place. The capacity may be practically composed of the patient, as one plate of a condenser, and the floor and walls of the room as the other plate, to which, if necessary, the capacity of a Leyden jar or other form of condenser may be added. In using ordinary electrostatic therapeutic apparatus the capacity may be thus reduced by using a smaller jar, and increasing the distance of the patient from surrounding objects, and particularly from the floor and nearest wall.

A comparison of the results illustrated in Figs. 2^D and 2^E shows that if it is desired to maintain unchanged the strength of the current, and the voltage to which the patient is charged, and at the same time increase the frequency and discharge rate, this can be accomplished by simultaneously increasing the inductance and reducing the capacity to the same relative degree, the discharge knobs and all

other conditions remaining unchanged.

CHANGES IN OSCILLATIONS RESULTING FROM CHANGES IN LENGTH OF SPARK GAP

It is obvious that by reducing the length of the spark gap the resistance of the circuit will be decreased, and the effect will be to increase the frequency. The discharge rate at which the successive sets of oscillations take place will also be increased, because the Holtz machine will charge the capacity of the circuit in a shorter time up to the lower voltage required to produce a discharge. The decreased resistance also tends to increase the strength of the current, which is more than offset by the current-reducing effect of the lessened quantity of charge for each discharge when the knobs are closer together; the net effect being a decrease in its strength. Therefore, if it is desired to operate in the direction of an increase in the strength of the current, and also insure its oscillatory character, it is to be done by leaving the adjustment of the knobs unchanged, and in other ways decreasing the resistance of the circuit in which the patient is included, rather than by drawing the knobs farther apart. The latter procedure, while increasing the strength of the current, may increase the resistance so much as to damp down the oscillations and cause the current to be pulsatory.

EQUATIONS FOR TRUE PULSATORY CURRENTS

Referring to the numerical illustration of the formula for frequency of an oscillatory current, given early in this paper, in which the total circuit resistance was assumed to be 1,000 ohms, it was there made plain that a discharge current will be oscillatory only when $\frac{R^2}{4L^2}$ is less than $\frac{1}{LC}$; or in other words, when R^2C is less than $4L$.

It is equally important to the physi-

cian to know the equations for a current when $R^2 C$ is greater than $4L$, and when equal to $4L$, under both of which conditions it will be a *true pulsatory current*.

General Case.) The general equation for the strength i , in amperes, of a pulsatory current at any time t , in seconds, after the current discharge has commenced to flow, and when $R^2 C$ is greater than $4L$, is

$$i = -\frac{Q}{\sqrt{R^2 C^2 - 4LC}} \left\{ e^{-\frac{(RC - \sqrt{R^2 C^2 - 4LC})t}{2LC}} - e^{-\frac{(RC + \sqrt{R^2 C^2 - 4LC})t}{2LC}} \right\}; \quad (17)$$

and the time taken for the current to arrive at its maximum value is

$$t_{\max. i} = \frac{LC}{\sqrt{R^2 C^2 - 4LC}} \log_e \frac{RC + \sqrt{R^2 C^2 - 4LC}}{RC - \sqrt{R^2 C^2 - 4LC}}. \quad (18)$$

The maximum strength of the current may be obtained by substituting the numerical value of $t_{\max. i}$, obtained by equation (18), for t in equation (17).

The equation for the mean value of the current from the commencement of discharge up to any time t is

$$i_{\text{mean to time } t} = -\frac{Q}{t\sqrt{R^2 C^2 - 4LC}} \left\{ \sqrt{R^2 C^2 - 4LC} - \frac{(RC + \sqrt{R^2 C^2 - 4LC})}{2LC} e^{-\frac{(RC + \sqrt{R^2 C^2 - 4LC})t}{2LC}} + \frac{(RC - \sqrt{R^2 C^2 - 4LC})}{2LC} e^{-\frac{(RC - \sqrt{R^2 C^2 - 4LC})t}{2LC}} \right\}. \quad (19)$$

Assuming the same circuit conditions as for the case shown in Fig. 2^A, excepting that the resistance is increased from 500 ohms to 1,000 ohms, and substitut-

ing the values of the constants in equation (17), it reduces to the form

$$i = -182.355 \left\{ e^{-23,240,000t} - e^{-143,426,666t} \right\}. \quad (20)$$

And by substitution in equation (18) the latter reduces to the form

$$t_{\max. i} = 0.0000000832 \log_e 6.171543$$

$$\text{or } t_{\max. i} = 0.0000000832 \times 1.82,$$

$$= 0.0000001514 \text{ second.}$$

The maximum value of the current may be obtained by substituting the last result 0.0000001514 for t in equation (20).

The following are the calculated results, from equation (20), for the strength of the current at the successive stated intervals of time after it has commenced to flow.

Time t in fractions of a second.	Instantaneous values i of current in amperes.
0.000	0.0
0.00000001	— 100.8
0.00000001514	— 106.55 max.
0.00000002	— 104.2
0.00000003	— 88.7
0.00000004	— 71.4
0.00000005	— 56.9
0.00000010	— 17.8
0.00000020	— 1.75

The duration of the *equivalent coulomb sine pulsation*, derived from equation (10), is 0.00000009693 second; and the periodicity, from equation (11), is 10,327,000.

The above results are illustrated in Fig. 2^F, in which A H B is the pulsatory discharge current, and A F E is the equivalent coulomb sine pulsation, the maximum height and area of the latter being equal to the maximum height and area of the current curve.

By doubling the resistance of the circuit, other conditions remaining the same as in the case illustrated in Fig. 2^A, and the product of the square of the resist-

ance multiplied by the capacity being thereby rendered greater than four times the inductance, the current has been changed from one slightly oscillatory to one that is wholly unidirectional and pulsatory, gradually dying away to a zero value in an infinite length of time. The increase in resistance also reduces the maximum strength of the current from -170.96 amperes to -106.55 amperes. Assuming that the spark gap and other operative features of the Holtz machine remain unchanged, as in the case illustrated in Fig. 2^A, the discharge rate will also be unchanged, and pulsations like that represented in Fig. 2^F will occur at the rate of 76 per second.

Another effect of the increase in resistance is that the time required for the current to attain its maximum strength is shortened from 0.000000019128 second to 0.00000001514 second.

It is not essential in the case illustrated in Fig 2^A that the resistance should be changed in order to make R^2C greater than $4L$, and thus cause the current to be pulsatory, as in Fig. 2^F, for this result can be accomplished either by increasing the capacity C , or by reducing the inductance L , and in fact by properly varying any one or simultaneously all of the quantities R , C , and L . Increase in capacity would tend to increase the strength of the discharge current, which would require more time to rise to its maximum value, and decrease in strength at a more rapid rate. Increase in inductance would tend to decrease the strength of the current, which would also require more time to rise in its maximum value, but decrease in strength at a slower rate.

Critical Case.) Another case of unidirectional or pulsatory discharge is that of the discharge that occurs when R^2C is equal to $4L$. Of all possible cases of condenser discharge this is the one in which the condenser is most completely discharged, and the current most nearly

disappears, in the shortest time; it is the *critical case* in which the discharge current is just on the verge of being oscillatory. It follows, therefore, that a certain amount of inductance in a circuit hastens the *practically complete* discharge of a condenser, and *practical disappearance* of the current. But, as will be evident later, by *far the greater part* of the total discharge, and dying down of the current, would occur quickest in a circuit of zero inductance.

The general formula for the strength i of the discharge current in the critical case at any time t after the current has begun to flow is

$$i = -\frac{Q}{CL}te^{-\frac{Rt}{2L}} \quad (21)$$

The time required for the current to attain its maximum strength is

$$t_{\max. i} = \frac{2L}{R} \quad (22)$$

The maximum strength of the current is

$$i_{\max.} = -0.73576 \frac{Q}{RC} \quad (23)$$

The equation for the *mean* value of the current from the commencement of discharge up to any time t is

$$i_{\text{mean to time } t} = -\frac{Q}{t} \left\{ 1 - \left(\frac{Rt}{2L} + 1 \right) e^{-\frac{Rt}{2L}} \right\} \quad (24)$$

Applying the formulæ, for illustration, to a case in which the circuit conditions are the same as for the case illustrated in Fig. 2^A, excepting that the resistance is assumed to be increased from 500 ohms to 693 ohms in order that the product of the square of the resistance by the capacity shall be equal to four times the inductance, and substituting the values of the constants in equation (21) it reduces to the form

$$i = -21,916,666,666te^{-57,750,000t}$$

And by substitution in equations (22) and (23) they reduce, respectively, to the forms

$$t_{\max. i} = 0.000000017316 \text{ second,}$$

and $i_{\max.} = -139.6 \text{ amperes.}$

The following are the calculated results for the strength of the current at the successive stated intervals of time after the current has begun to flow:

Time t in fractions of a second.	Instantaneous values i of current in amperes.
0.000	0.0
0.00000001	— 123.0
0.000000017316	— 139.6 max.
0.00000002	— 138.0
0.00000003	— 116.3
0.00000004	— 86.8
0.00000005	— 61.0
0.00000007	— 26.9
0.00000010	— 6.8
0.00000020	— 0.042

The duration of the equivalent coulomb sine wave of the current is, from equation (10), equal to 0.000000074 second; and the periodicity, from equation (11), 13,513,500.

The foregoing results are illustrated in Fig. 2^G, in which A H B is the pulsatory discharge current, and A F E the equivalent coulomb sine pulsation.

Zero Inductance.) A special case of pulsatory discharge, which is only theoretically possible, but can be closely approached in practice, remains to be considered; namely, the pulsatory discharge that would occur if the inductance of the circuit could be reduced to zero. In this case the current would be necessarily pulsatory because with a finite resistance and capacity, and zero inductance, $R^2 C$ would still be greater than $4L$.

If $L=0$, then

$$\frac{RC - \sqrt{R^2 C^2 - 4LC}}{2LC} = \frac{1}{RC},$$

and $\frac{RC + \sqrt{R^2 C^2 - 4LC}}{2LC} = \infty$; and by

substitution in equation (17), we obtain as the general equation for a pulsatory

current in a circuit of zero inductance

$$i = -\frac{Q}{RC} e^{-\frac{t}{RC}}. \quad (25)$$

The maximum value of the current discharge would be

$$i_{\max.} = -\frac{Q}{RC}. \quad (26)$$

The current would rise instantly to its maximum value, which follows not only from the form of equation (25), but is obvious from the physical fact that inductance is the only factor in a circuit that acts to oppose *change* in strength of the current.

The mean strength of the current from the commencement of discharge up to any time t would be

$$i_{\text{mean to time } t} = -\frac{Q}{t} (1 + e^{-\frac{t}{RC}}). \quad (27)$$

Applying the formulæ to a case in which the circuit conditions are the same as for the case illustrated in Fig. 2^A, excepting that the inductance is decreased from 0.000006 henry to zero, we have

$$i = -\frac{40,000,000t}{263e},$$

and $i_{\max.} = -263 \text{ amperes.}$

The following are the calculated results for the strength of the current at the successive stated intervals of time.

Time t in fractions of a second.	Instantaneous values i of current in amperes.
0.000	— 263.0 max.
0.00000002	— 117.9
0.00000005	— 34.2
0.00000010	— 4.8
0.00000015	— 0.65

The duration of the equivalent coulomb sine wave of the current would be, from equation (10), 0.00000003927 second; and the periodicity, from equation (11), 25,464,700.

The foregoing results are illustrated in Fig. 2^H, in which A H B is the pulsatory discharge current for zero inductance.

tance, and A F E the equivalent coulomb sine pulsation.

It is interesting to note that the rate at which a pulsatory current would die down in a circuit of given resistance R and capacity C , if the inductance L could be reduced to zero, would be the same as the rate at which an oscillatory current will die down in an inductive circuit of the same resistance and capacity, if in the latter case $2L$ is equal to $R^2 C$.

GENERAL CURRENT CHARACTERISTICS OF A HOLTZ MACHINE CIRCUIT

In Figs. 2^A to 2^{II}, inclusive, only the characteristics of the current, such as frequency, strength, and wave-shape during a single discharge between the knobs of the prime conductors, are illustrated. It is a matter of much interest and importance to the physician to understand not only the characteristics of the discharge current, but also the nature of the other electrical operations that go on in the circuit, both during the time the Leyden jar, or other form of condenser, is discharging, and also while being charged by the Holtz machine up to the potential required to produce another discharge.

To this end the electrical operations which take place in the circuit (in which the body of a patient may be assumed as included) during the successive discharges of the jar and intermediate intervals of time during which the jar is being charged, are illustrated in Fig. 3, in which the curves 1, 2, 3, in heavy lines, represent three successive discharge currents. These discharges are, as shown, non-oscillatory; but they may be considered as representing oscillatory discharges substantially like the current-wave shown in Fig. 2^A, the negligibly small oscillation in the positive direction, below the zero, or base line, in Fig. 2^A, being omitted in Fig. 3.

Starting from the time m at which the negative discharge current 1 has

practically ceased to flow, the relatively extremely small positive charging current A B begins to flow from the Holtz machine into the jar in the opposite direction. The accumulation of charge, or coulombs of electricity, in the jar, delivered to it by the continuous flow of the charging current, gradually, but with comparative slowness, raises its voltage, or the difference of electrical potential between its inner and outer coatings, and therefore between the discharge knobs of the machine, in the negative direction, that is, in opposition to the voltage of the charging current, as shown by the curve C D, until finally at the time n the negative voltage has risen to an amount necessary to break down the resistance of the air in the gap between the knobs and cause a spark discharge to pass between them.

The gas in the path of the spark, heated to incandescence and rendered electrically conductive thereby, closes the local circuit, which includes the spark, Leyden jar, and also, say, the body of a patient, and the jar begins to discharge the stored electricity into the local circuit. The voltage which was slowly raised to the sparking pressure under the flow of the very feeble charging current during the time $m n$ falls with enormous rapidity, as indicated by the dotted line D E F, and produces the relatively very strong discharge current 2 in the opposite, or negative direction during the comparatively extremely short time np .

At the time p the feeble charging current again begins to flow into the jar, and raises its voltage until another spark passes and another discharge current 3 flows in the local circuit. This cycle of changes is repeated so long as the Holtz machine is in operation.

As has been experimentally demonstrated by Prof. Sheldon, the Holtz machine generates a continuous current of constant, though feeble strength, represented in Fig. 3 by the dotted line X X.

But not all of the current generated will flow into a Leyden jar because the voltage of the jar, in opposition to the charging current, causes a percentage of that current to leak off along other paths instead of flowing into the jar, and this leakage increases, and reduces the amount of current flowing into the jar, as the voltage rises, and also diminishes the rate of increase in voltage. These facts are illustrated in Fig. 3, which shows the diminishing strength of the charging current A B from the time m when it begins to flow until the time n when it ceases to flow into the jar; and also shows by the curvature of the voltage line C D, a reduction in the rate of increase in voltage as the latter increases in amount. If the charging current A B were of constant strength, the voltage would increase at a constant rate, and C D would be a sloping straight line.

During the time $m n$ in which the jar is being charged the difference between the strength of the charging current A B, flowing into the jar, and the strength of the total current X X, generated by the Holtz machine, represents the current lost in leakage. During the time $m n$, when the discharge current is flowing out of the jar and in the local circuit, the whole current X X generated by the Holtz machine flows through the discharge spark, but not through any other part of the local circuit. The machine is in fact then short-circuited through the spark gap.

In the examples illustrated by Figs. 2^A to 2^H , inclusive, it has been assumed that a constant charging current of $\frac{1}{2}$ milliamperes flows into the Leyden jar, and upon this assumption the rate of charge and discharge of the jar, and also the relative duration of a discharge and the interval of time between successive discharges were determined. This assumption has led to results not at variance with the truth; for it would have been equally correct, and justified by the results of Prof. Sheldon's tests, to have

assumed that the strength of the charging current diminished as the voltage of the jar increased, but that its *mean or average strength* was $\frac{1}{2}$ milliamperes.

It is to be understood that the curves in Fig. 3 are only illustrative of qualitative electrical operations, and are not so drawn to scale that the relative magnitudes of the operations going on in the circuit can be directly compared from the diagram.

Assuming, as an example, that Fig. 3 illustrates a series of charges and discharges taking place under the conditions stated in connection with Fig. 2^A , then, in Fig. 3, the average height of the curve of charging current A B stands for $\frac{1}{2}$ milliamperes. The maximum height of the discharge current wave will then represent 170.96 amperes; the maximum height of the voltage curve, 131,500 volts; the time of discharge $n p$, 0.00000078609 second; and the interval between successive discharges, or time of charging $m n$, 0.01315 second.

Now if the height of the charging current A B at the time m be 1 milliamperes, *on the same scale the curve of discharge current should be 12,500 times taller than shown in Fig. 3.* To show the voltages on the same scale as the amperes, *the voltage curves would have to be 2,922,222 times taller than in Fig. 3.* As drawn in the figure, the intervals of charge, or time $m n$, are 20 times longer than the duration $n p$ of flow of a discharge current; taking the distance $n p$ as the scale of time, the distance $m n$, or *time of charge should be 8,364 times longer than actually shown in Fig. 3.*

GENERAL DIRECTIONS FOR OBTAINING OSCILLATORY CURRENTS OF HIGH FREQUENCY

A careful study of Dr. Sheldon's paper, and the preceding examples, illustrated in Figs. 2^A to 2^H , will indicate that it is doubtful, to say the least, whether in many cases where the physician has been accustomed to think that

high-frequency oscillatory currents were present, and has attributed his successful results thereto, they were, as a matter of fact, present at all. Direct-current high-periodicity pulsatory discharges might be easily confused with oscillatory currents of high frequency, and unfortunately we have, as yet, no measuring or indicating instrument which can be applied, like a volt meter, by the practitioner to directly measure the high frequency of oscillatory discharges, or the periodicity of pulsatory discharges, or distinguish one character of discharge from the other.

Hence it becomes important, especially at a time when extraordinary virtues and advantages are being attributed to high-frequency oscillatory currents, to know how to produce them with certainty when desired, even though we may not be able, without difficult experimentation, more or less assumption, and laborious calculation, to reasonably satisfy ourselves as to *how high* their frequency is.

The following suggestions may be of assistance. They are, so to speak, thumb rules:

1. *Reduce the resistance of the entire circuit as much as possible relatively to the inductance.* To this end, remember that, as Prof. Sheldon has shown, the resistance offered by a conductor to the flow of high-frequency currents may be ten or more times greater than its resistance to low-frequency, or to continuous, currents; and the conductor should be of liberal size, considering the maximum current to be carried. Remember also that, as Prof. Sheldon has pointed out, the greater part of the whole resistance may reside in the spark gap, which, therefore, should be as short as possible consistent with the production of effects of the desired intensity. Remember especially that the resistance of the patient may vary within wide limits, is difficult to determine, and without taking special precautions is liable to be

high; therefore it should be made as low as possible by the use of large contact surfaces at the electrodes, moistened with a saline solution, or by equivalent means.

2. *Keep the capacity of the circuit low relatively to the inductance.* Remember, however, that some capacity is absolutely necessary to the production of oscillatory currents, and that the strength of current, and massage effect upon a patient when so placed in the circuit as to constitute one condenser plate, are practically dependent in some degree upon the capacity. If in the treatment of a patient it is desired to simply pass the current through his body, *as a conductor*, without any other effect than that which will be directly produced by the current flow, the capacity of the circuit must be localized outside the patient by means of condensers independent of him (as, for example, in the Morton "static-induced current" apparatus, illustrated in Fig. C in this committee's report for last year), so that the patient shall practically form simply a part of the conductor by which the outside coatings of the two Leyden jars are connected with each other. But if it is desired to subject the patient to massage effects due to the condenser action of alternate electrical charges and discharges (the current flowing in the patient in such application being merely a necessary incident of the treatment, and not considered as a part thereof) the capacity must be localized *within or upon* the patient, as, for example, in the Morton "wave current" apparatus, illustrated in Fig. F in the report for last year.

3. *Increase the inductance relatively to the resistance, if for practical reasons the latter cannot be made very low.* The objections to increasing the inductance, if avoidable, are that it tends to decrease the frequency and strength of current, and therefore, in the application of the condenser massage treatment, tends to reduce the vigor and rapidity of

the massage. The inductance may be readily increased when necessary by inserting a reactance coil in the circuit, consisting of a few turns of large diameter of heavy copper wire, with considerable space between neighboring turns, and without an iron core.

It is to be understood that in pointing out, as above, a way of obtaining oscillatory currents of high frequency for application to a patient, this committee does not intend to express any opinion as to their therapeutic value, of which, naturally, the physician must be the judge.

These considerations as to practical and easy methods of securing high-frequency oscillatory currents, point to the great desirability of making numerous experimental measurements of the capacity and resistance of human subjects, under the conditions customarily present in general practice, and preparing a table giving the mean results of many tests.

PHYSIOLOGICAL EFFECTS OF HIGH FREQUENCY

Assuming that the rapidity of the cycles, or frequency, of oscillatory currents has a vital bearing upon the therapeutic value of such currents, it becomes most important that the physician should know at what frequency, or between what limits of frequency, the best curative effects are to be obtained.

That the therapeutic effect of an oscillatory current may be related to its frequency is perhaps indicated by the difference between the physiological effects produced by a continuous current, or by an alternating current of the comparatively low frequency of 25 to 60 cycles per second, such as the frequency of the current from the ordinary alternating generator used in electric light and power-transmission plants, and the effects of a current of the undoubtedly high frequency of several thousands or even millions of cycles per second, such

as the oscillatory current that can be produced by the apparatus of D'Arsonval, Tesla, and Dr. Morton, all of which were described in the report of last year; also by the apparatus of Prof. Elihu Thomson of this committee, described by him in a paper entitled "Notes on the Effects of High Frequency Electrical Discharges passed through the Body," and read before this association ten years ago.*

D'Arsonval passed through two persons a high-frequency current of sufficient strength to bring a one-ampere incandescent lamp in series with them up to a white heat, and through his own body a high-frequency current of "more than three amperes" without any other effect than a sensation of heat in the hands.

In experiments by Prof Thomson, described in his paper above referred to, the current, passing through his body from hand to hand, had at times a mean effective strength as great as 1.5 amperes, as gauged by its heating effect upon an incandescent lamp, and produced no other physiological effect than the sensation of warmth in the wrists, which was felt because of the noteworthy generation of heat due to the comparatively high resistance localized at these points of the electric circuit. Physiological tetanus of the muscles was altogether absent. The reason for the absence of physiological tetanus with high-frequency oscillatory currents, and its presence with continuous currents, or electric light and power alternating currents of the comparatively low frequency of 25 to 60 cycles per second, is not at present known with certainty. Some authorities hold that this absence is due to the fact that because of the high frequency such currents are compelled to flow practically on, or so near the surface of, the body that they do not

* *Transactions American Electro-Therapeutic Association for 1894, page 261.*

penetrate to the nervous and muscular systems, as would a low frequency or a continuous current, and therefore have no effect upon them. On the contrary, other authorities believe that the circulatory and nerve channels, compared with the tissues at and near the surface, constitute such superior conductors of electricity that the high-frequency currents flow therein to a large degree in spite of the tendency of the high frequency to force them to the surface, and that the presence or absence of tetanus is governed by the degree of frequency.

And it is this absence of tetanus, and the resulting harm, that constitutes the most obvious difference between the effects produced upon the living subject by high-frequency currents, and those resulting from low-frequency or continuous currents.

The line of demarkation between high-frequency and low-frequency currents, or the frequency at which tetanus begins to stop and immunity from tetanus commences, has not been clearly defined. Experiment has shown that at a frequency of about 10,000 cycles per second tetanus does not take place.

THERAPEUTIC VALUE OF HIGH PERIODICITY PULSATORY CURRENTS

Inasmuch as the physician has been generally unable in the past to determine with certainty whether the currents applied by him to a patient were oscillatory or pulsatory, or perhaps oscillatory currents so rapidly damped as to be *practically* pulsatory, as in the case involving easily possible clinical conditions in the application of the Morton "wave current" illustrated in Fig. 1, the inquiry is pertinent whether, after all, the therapeutic value of discharge currents from a condenser depends upon their being oscillatory in character?

Without doubt, what have heretofore been referred to by medical writers as high-frequency *oscillatory* currents have

been, in many cases, high-periodicity *pulsatory* currents, due mainly to the high resistance of the circuit; and the additional inquiry is timely, whether the latter class of currents may not be credited with as great curative properties as the former, particularly when the immediate effect of either current is to alternately charge and discharge the patient (in whole or in part, depending upon the location of electrodes) as one plate of a condenser; the result of which is a succession of mechanical attractions or pulls between the patient and the floor and walls ordinarily constituting the other plate, which act synchronously with the charges and discharges, and produce a mechanical massage which is apparently of a penetrating character, acting upon each individual cell of the living tissue?

If the therapeutic value of condenser discharge currents is due to a massage effect, then why are not pulsatory currents of high periodicity as efficacious as oscillatory currents of high frequency, when the *rate* at which the patient is alternately charged and discharged is the same in both cases, that is, when the patient is subjected to the same number of current pulsations and accompanying massage effects in a given time, it being understood, of course, that such an adjustment of apparatus and circuit conditions is made that substantially equal massage effects are produced in both cases?

If they are equally efficacious, the employment of proper means for obtaining a low resistance in the circuit is indicated, not primarily because a low resistance tends to the production of a prolonged oscillatory current with many slowly damped pulsatory effects, as is the fact, as shown by Fig. 2^B, and the theoretical case of Fig. 2^C, but because it is the readiest and most convenient way in which to obtain the greatest number of pulsatory effects in a given time.

The fact should not be overlooked,

however, that the requisite number of pulsatory effects is not necessarily to be obtained in every instance by only reducing the resistance of the circuit. For in many cases the same result might be secured by a proper relative adjustment of the length of spark gap, resistance, inductance, and capacity.

The therapeutic value of condenser discharge currents, as an agent for producing tissue massage, may be considered, however, from still another point of view, which, in the opinion of this committee, is worthy of the most careful attention on the part of the physician.

Animal tissues, and each individual cell thereof, have mechanical inertia, due to their mass; and consequently time is required for the mechanical attraction or pull upon the patient, as one plate of a condenser, to displace and deform the tissues and cells, and thereby produce a massage effect.

Therefore, the question naturally arises: can each half-oscillation of a so-called high-frequency current, having a frequency running up into, say, millions of oscillations per second (as, for example, in Fig. 2^B), produce any sensible displacement and deformation of the tissue, and thereby a massage effect, by the resulting mechanical pull, which may last for only the fraction of a millionth of a second?

If the individual half-oscillations of a high-frequency current cannot, for want of time, produce separate massage effects, then the only massage effects produced will be those due to each charging and discharging of the patient. They will occur, therefore, at a rate equal to the rate at which discharges take place across the spark gap of the Holtz machine; and will be independent of the fact whether the current is oscillatory or pulsatory. If frequency is not an influential factor in the condenser-massage application of discharge currents, such relative adjustment of the length of spark gap, condenser capacity of the cir-

cuit including the patient, and speed of the Holtz machine as will result in a rate of discharge across the spark gap, and strength of current suitable to the particular case under treatment, will be the main factors to which to give attention; and special adjustment of resistance, inductance, and capacity for the particular purpose of obtaining an oscillatory current of high frequency becomes unnecessary.

After all, is not the electrostatic machine from the standpoint of electrotherapeutics, simply a convenient practical means of producing a series of more or less rapidly variable effects each of extremely short duration; and does not the greatest therapeutic value of the current from such a machine result from these rapid variations, especially those derived from condenser action, irrespective of whether the current of the discharges happens to be oscillatory and thus flows in alternately opposite directions, or is pulsatory and flows in only one direction? These are questions to which the physician may well give serious consideration.

Of one thing we may be reasonably certain: the greatest value of the electrostatic generator thus far discovered resides in its ability to produce very high voltages with amperage so low that rapid electrical and mechanical variations can be carried on in the human system, expending sufficient power to insure prompt changes, without the necessity of employing average current flow so great as to destroy by electrolysis or excessive heat the delicate structure which it is the object of the treatment to repair.

MECHANICAL ANALOGUE OF LEYDEN JAR DISCHARGE CURRENTS

Mechanical analogues are often very helpful aids to a ready comprehension of the nature of electrical operations going on in a circuit, and an understanding of the relative influence of the characteristics of the circuit in causing, or

modifying, such operations. And in no class of electrical operations should a mechanical analogue prove more useful to the physician than in the complicated phenomena resulting from Leyden jar discharges.

Thanks to Dr. Oliver Lodge,* a very simple and readily applied analogue, widely recognized as conveying correct ideas, is available.

A horizontal flat spring, immersed in a fluid, is loaded with a ball at one end, and fixed at the other end so as to vibrate sideways, in order that gravity shall have no influence upon its motion.

Now if the spring be bent aside and let go, its motion and speed, respectively, will be analogous to the direction of flow and strength of current produced in a circuit by a Leyden jar discharge. The pliability (inverse of stiffness) of the spring corresponds to the capacity of the circuit; the distance it is bent aside corresponds to the quantity of charge; the load or inertia of the ball represents the inductance of the circuit; and the viscosity friction of the fluid corresponds to the electrical resistance; the analogy being perfect if the viscosity friction be assumed to vary in exact proportion to the speed.

The following examples to illustrate the application of the analogue should prove instructive:

(a) Let it be assumed that the spring be of such pliability that when loaded with an aluminum ball, immersed in water, bent aside and let go, it will vibrate back and forth on either side of the zero position of rest, the oscillations dying down slowly. This example may be taken to represent a case analogous to that of the Leyden jar oscillatory current discharge illustrated in Fig. 2^B, in which the frequency corresponds to the rate of oscillation or frequency of the

spring. Experiment will demonstrate that the rate of the oscillations and their dying down are independent of the distance to which the spring is bent aside when let go, and that the amplitude of the oscillations is alone dependent upon this distance and is directly proportional thereto; which corresponds to the fact that in electrical discharges the amplitude of the current strength of the oscillations is alone proportional to the amount of charge.

(b) Now gradually increase the viscosity resistance by slowly dissolving sugar in the water, and let the spring be bent aside the same distance as in example (a). As the liquid becomes thicker the resistance increases, and the oscillations decrease in frequency, and also in amplitude, and die down more rapidly, until finally the liquid becomes so thick, and consequently the resistance so great, that the spring will gradually return to the zero position of rest without making a single oscillation past this position. The last condition may be taken to represent a case analogous to that for the Leyden jar pulsatory current discharge shown in Fig. 2^F. If the liquid is thickened just enough to permit the spring to return to zero position in the shortest possible time without overshooting the mark, the case will be analogous to that shown in Fig. 2^G.

(c) With all other conditions of example (b) unchanged, let a copper ball of the same size as the aluminum ball be substituted therefor. The mechanical inertia, corresponding to electrical inductance, will be thereby increased several times, and if the spring is again bent aside and let go it will no longer gradually return to the zero position and stop there, but will oscillate back and forth across the position of rest with gradually decreasing amplitude. This example illustrates the effect of inductance in tending to cause oscillations of a discharge current, in opposition to the tendency of resistance to suppress them.

**The Electrician*, Vol. XXI, p. 41, London, May 18, 1888. Fleming's "Alternate Current Transformer," Vol. I, 3d ed., p. 387, London, 1900.

(d) If now the spring with the copper ball be again immersed in clear water it will oscillate with a greater frequency and amplitude, and the oscillations will be more prolonged than in the sugar syrup of example (c); but the frequency and amplitude of the oscillations will not be so great as when the spring is in water, but with the aluminum ball, as in example (a), although the oscillations will not die down as rapidly. This example (d) may be taken to represent a case analogous to that for the oscillatory current discharge shown in Fig. 2^D, which, as compared with Fig. 2^B, illustrates the effect of inductance in prolonging oscillations, although at the same time reducing the strength and frequency of the current.

(e) Returning to example (a), let the spring be replaced by one much stiffer; that is, less pliable. By this change the rate of oscillation or frequency, and the damping down of the oscillations, will be increased, while their

amplitude will be diminished. This example may be taken to represent a case analogous to that for the oscillatory current discharge shown in Fig. 2^E, which illustrates the effect of decreasing the capacity; and to make the analogy more exactly fit the case of Fig. 2^E, in which the quantity of the charge automatically becomes less than in the case of the other figures, it should be assumed that the same force is applied to bend the stiffer spring aside as is applied to bend the more pliable spring of example (a), with the result, that the former will not be bent to the same extent as the latter, which will be analogous to a smaller amount of charge.

Having explained with some care the character of Dr. Lodge's analogue, and its relation to a circuit subjected to Leyden jar discharges, and illustrated its application by a few examples, its further application to the various conditions that may occur in the physician's practice is left to his ingenuity.

THE USE OF ROENTGEN RAYS IN THE DIAGNOSIS OF FOREIGN BODIES IN THE CRANIUM*

BY KATE CAMPBELL MEAD, M.D., OF MIDDLETOWN, CONN.

PROF. MORITZ BENEDIKT of Vienna, who was one of the first to demonstrate the value of Roentgen ray diagnosis in diseases of the heart, blood vessels, and abdominal organs, has been working with energy for the last two years on brain-photography. He has now scores of photographic plates of the brain, which show very clearly the presence of hæmatoma, abscess, or other tumors of the brain-substance, with or without thickening or

injury of the bones of the skull. He has also demonstrated spondylitis, and other diseases of the spinal cord in their earliest stages.

That this is one of the greatest triumphs of modern science there can be no doubt, for it seems not only a great saving of time, perhaps even life to the patient, but in the case of a legal action for damages it makes clear to all concerned the nature of the injury.

By Prof. Benedikt's Roentgen-photographic plates it has been demonstrated recently that "Railway Shock" is actually caused by hemorrhage or other anatomical and pathological process in

*Read before the Middlesex County Medical Society, October 12, 1904.

the brain. It had long been taught by Charcot and his followers that "Railway Spine" was merely a "hysterical manifestation," and for this reason the discovery of a focus of bleeding, or of meningeal inflammation and of actual pachy-meningeal hæmatoma, which could be clearly seen in the "negative" of a photographic plate, caused much surprise and controversy among investigators.

During 1902-1904 Prof. Benedikt made numerous photographic plates from traumatic epileptic cases, in which railway accident had played no part, and these plates showed very clearly the changes which had taken place in the meninges and brain, leaving no doubt about the nature of the intracranial anatomical alteration.

Prof. Benedikt now says definitely that owing to a "difference of penetrability," any tissue which lies between the X-ray tube and the photographic plate affects that plate. Every substance which has a density or penetrability different from the brain tissue itself makes a shadow or a lighter spot on a picture of the brain.

All of the cavities in the cranium, if properly photographed, may be seen on these "negatives." The frontal, sphenoid, and ethmoid cavities appear with perfect distinctness. This is due to the fact that these cavities all contain air, and air diffuses X-rays. Therefore these cavities seem brilliant as they appear on the plate. Wherever the quantity of air is great the brilliancy blurs the picture, as, for instance, in photographing the lung, where it is sometimes impossible to show all of the cartilage or solidified spots if there are many large cavities.

For the same reason investigators had great difficulty in photographing the abdominal organs unless the bowels were collapsed and free from air and fat, for fat causes this same "brilliancy" and blurs the picture.

In an X-ray negative of the brain may be seen all of the bony outlines of the skull from the point of the nasal bone to the occiput and base. The intermediate space is filled in by a gray cloudy shadow which represents the bulk of the brain "optically influenced" by the lateral walls of the skull.

The most remarkable fact in these brain photographs is that all of the cavities of the labyrinth appear. This proves that all of the tissues of the head and brain through which the X-rays pass must also appear in perspective in the picture owing to their own "difference of penetrability."

Every abnormal condition on the surface of the brain or in its interior is faithfully represented in the "negative" either as a shadow or a lighter spot, depending on the penetrability of the pathological process.

In those cases in which there has been any localized disease or injury it is surprisingly easy to differentiate on the plate the hæmatoma or abscess from the brain tissue, or any localized thickening of the bone-plates, or any enlargement of the sinuses, or the exact area of a pachymeningitis.

These shadows or outlines, though clearly discernible in the "negatives," are not shown distinctly in the prints because they are too faint to reproduce. But to Prof. Benedikt, who has studied the plates very carefully, the slightest shade on the "negative" has its meaning.

In order to localize the disease most accurately he photographs both sides of the head in profile and takes great care that the median plane of the head shall be parallel with the photographic plate in order to avoid confusion of double shadow. Notwithstanding this care the pyramid of the opposite side of the skull does appear on the plate for the two reasons that human heads are never symmetrical, and that patients will never lie perfectly still; very naturally

if the head is turned in the least out of the plane there is cast a shadow of one pyramid above and behind that of the side directly photographed.

While in Vienna in the summer of 1904, I had the pleasure of seeing photographs taken of both sides of a brain in Prof. Benedikt's laboratory at the "Polyklinik," and of studying several dozens of such photographs in Prof. Benedikt's office. It took no imagination whatever to see on these plates the shadows, or the light spots denoting disease in or upon the brain, or to note any irregularity of outline of brain or of bone, or any unusual thickening of bones or sinuses.

As regards the technique of making an X-ray picture of the brain there is some difference of opinion as to the strength of the current and the number of interruptions which it is best to employ.

For the picture that I saw taken the X-ray bulb was placed 1 foot above the girl's head, the exposure lasted 3 minutes, and the parts of her face and neck not taken were covered with strips of lead.

The "negatives" which are now made in Prof. Benedikt's laboratory give a much greater opportunity for the securing of detail than was attainable in his "negatives" taken two years ago, although these latter showed the location of all the gross pathological lesions.

Prof. Benedikt showed me the "negatives" from about eighteen cases, out of a large pile of X-ray brain pictures which had been made in his laboratory. Among these "negatives" I saw some which were taken from a case of epilepsy during pregnancy. Two of these were taken in 1902, and two in 1904; all showed irregular deposits of bone on the skull, but these thickenings were more

clearly shown, however, in the latter photographs. I also saw four pictures of the brain of an epileptic showing a large, distinct focus in the center of the brain, and two less distinct shadows (foci) in front and behind. Here, too, the later photographs showed greater detail than the earlier ones.

Three photographs from a case of traumatic hemorrhage in the brain were especially interesting, in connection with the history of the case. The first picture showed a large diffused cloud on the surface of the brain, denoting a large hemorrhage. After the patient had rested three months a second picture was taken, which showed a very much smaller cloudy area in the brain; evidently the hæmatoma had been partially absorbed. Three months later the patient, who in the mean time had been working as a porter, suddenly developed severe attacks of headache and nausea. A new photograph of his head was taken which showed again a much greater area of shadow than in the second picture, and was undoubtedly caused by a fresh hemorrhage.

I saw many other interesting and distinct photographs of brains of epileptics and apoplectics, all showing pathological shadows in the precise position where such pathological processes should be in order to account for the symptoms of the patient.

Not every pathological condition in the brain can be localized by its symptoms, and not many cases are operable, but at least they can be seen by X-ray pictures; and Prof. Benedikt has demonstrated again the great value of X-ray diagnosis in diseases of the brain and its coverings, and proved the fact so clearly as to satisfy every unprejudiced observer who has the opportunity of seeing his plates.

EDITORIAL

CURRENT CLASSIFICATION AND NOMENCLATURE

One of the most important elements in the successful therapeutical employment of electricity, is the judicious selection of that modality whose physical properties are most logically applicable to the pathological peculiarities of the condition which it is desired to influence. The attainment of this object implies a degree of detail in the knowledge of the physical properties of the different "currents" which has been unattainable in the past. The committee on Current Classification and Nomenclature of the American Electro-Therapeutic Association, however, has been investigating this subject for the past three years and has succeeded in amassing *data*, which are not only new and of practical value from a physical standpoint, but with which every physician employing electricity should familiarize himself.

The third report of this committee embodies information bearing upon this subject, which is considered of sufficient value to justify giving up to it practically the whole of this issue of *THE ARCHIVES*, and we desire to recommend to our electro-therapeutical readers a close study of this excellent piece of work. The frequency with which many electro-therapeutists confound the high-frequency with the oscillatory static and static-derived currents, not to mention other misconceptions of like character, are indications that this report is timely and appropriate, and that the carefully-performed work of this important committee will meet with the appreciation it so richly deserves.

ELECTROLYSIS OF PLATINUM

It is well known that platinum is not electrolysed by a direct electrical current, but according to an editorial in the *Electrical Review* for April 15, 1905, Messrs. A. Broshet and J. Tiet have found that if the current *varies*, electrolysis does take place. The electrolyte with which these gentlemen experimented was sulphuric acid. This discovery may have some bearing upon the use of platinum in the making of electrodes in the future.

CHANGE IN TIME OF ISSUE

Beginning with the current number, *THE ARCHIVES OF PHYSIOLOGICAL THERAPY* will be issued on the First of the month, instead of the twenty-fifth as heretofore.

CURRENT PHYSIOLOGICAL THERAPY

ARCHIVES D'ELECTRICITE MEDICALE

Bordeaux, France, April 10, 1905.

1. The N-Rays do not Modify the Electrical Resistance of a Selenium Pile or the Effect of Light upon this Resistance — Dr. H. Guilleminot.
2. The Distance Factor in Radiotherapy — Dr. J. Belot.
3. Method and Apparatus for Dosage of Static Electricity — Dr. Benoist.
4. On a Practical Modification of Dean's Radio-Limitator — Dr. E. Mollaret.
5. Radiotherapy and Radiography in England — Prof. Jaime R. Costa.

1. The source of the N-rays in this test was a Nernst lamp provided with a screen consisting of two thin sheets of aluminum separated by an air space. These shut off the heat and light rays and permitted the passage of the N-rays. No matter what source of current was employed, alternating electric light circuit, induction coil, or battery of storage cells, and whether in diffuse light or not no effect was produced upon the resistance by the action of the N-rays.

2. Belot lays down two laws.

First. The quantity of radiation received normally (i. e., vertically) upon a given surface varies inversely as the square of the distance from the anticathode.

Second. The quantity of radiation received obliquely diminishes in proportion to the size of the angle thus produced. The anticathode should be placed as near as practicable in order to reduce the time of exposure. Thus if it requires five minutes to produce a certain effect at a distance of 10 centimeters, it would require 20 minutes at 20 centimeters, 45 minutes at 30 centimeters, or an hour and a half at 40 centimeters.

Then again there is an additional loss of quantity because of the diffusion which the X-ray undergoes in passing through the air.

If the surface to be treated is of any size the tube must be far enough away to give approximately the same quantity over its whole extent. This he calculates to mean that the distance from the anticathode must be twice as great as the largest diameter of the surface exposed. If the disease is of such large dimensions that this rule would require the tube to be so far away as to make the exposure inconveniently long, only a part of the surface may be exposed at a time. Each of the fractional areas is then treated according to the law. He suggests the use of a mechanical apparatus which should carry the X-ray tube over all parts of a large diseased area and always at a uniform distance from the surface.

When a surface is concave the rays may fall equally upon all parts if the anticathode is at the center of curvature; but if the surface is convex, as in treating the entire scalp, it is necessary to divide it into smaller areas and change the position of the tube in order to get a uniform effect.

Coming now to the consideration of the thickness of tissue to be penetrated; if the anticathode is at a distance of 10 centimeters from the skin over a tumor of the breast five centimeters thick, the skin would receive two and a quarter times the quantity that would reach the deeper parts of the tumor. This is mathematical calculation on the supposition that the absorption of the tissues was the same as that of the air. But if the tube were at a distance of 100 centimeters the difference between the distances to the skin and to the deeper part of the tumor would be relatively slight.

The law is that the further the tube is from the surface the more uniform is the action of the X-ray throughout the entire thickness of the part, but of course it is to be applied within reasonable limits.

3. Benoist says that measurements of static electricity based upon the number and size of plates, the speed at which they revolve, etc., are very indefinite because of the wide variations in effectiveness of different apparatus and of the same apparatus under different conditions. A patient seated upon an insulated platform and in communication with a static machine, may be considered as being covered with a layer of electricity of uniform thickness, as long as the loss of electricity and its renewal by the action of the machine remain uniform. This electric density is the quantity of electricity upon a square centimeter of the external surface and constitutes the principal factor in the physiological and therapeutic effects of the static bath. The electro-static tension is proportional to the square of the electrical density. The density is greater over projecting points, but the measurement is of the quantity of electricity upon a square centimeter of the palm or back of the hand, this change being taken up by an insulated metal disk which is then discharged into a suitable electrometer.

The units are C. G. S. electric units, one of which is the quantity of electricity which, concentrated at a distance of 1 centimeter from an equal quantity of the same sign, repels it with a force equal to one dyne, i. e., about equal to the pressure of one milligramme. This is only one thirty-millionth of a coulomb; one coulomb being the amount transferred in one second by a current of one ampere. In place of the phrase "one thirty-millionth of a coulomb" Benoist proposes the name Franklin for the C. G. S. unit and would say that a static bath has a dose of 10 franklins when the density measured upon the dorsal or

palmar surface of the extended hand is 10 franklins per square centimeter.

He gives a figure of his Electrodensimeter which consists of an insulated metal disk with handle and protecting case to take the charge from the surface of the hand; and an electrometer whose movable arm indicates directly upon a scale the number of franklins per square centimeter on the surface tested.

4. Mollaret adds to the Dean localiser of lead glass with a window, a wooden clamp to secure the X-ray tube in a fixed position. This wooden clamp is screwed fast to the Dean localiser by screws passing through two layers of wood, one external and the other internal, and through the lead glass itself.

5. Prof. Costa concludes his brilliant series of articles upon the practice of radiology in Europe by describing the work done in England.

BULLETIN OFFICIEL DE LA SOCIÉTÉ FRANÇAISE D'ELECTROTHERAPIE ET DE RADIOLOGIE

Paris, France, March, 1905.

1. Albuminuria relieved by Electric Light Baths — Dr. Bilinkin.
2. Note on the Electrical Reactions in Two Cases of Sleeping Sickness — Dr. Delherm.

1. Bilinkin gave electric light baths in such a way that during the first four

	Man of 52	Woman of 48	Woman of 29
Before treatment	2.0 grammes	1.5 grammes	1.10 grammes
After			
1st bath	1.9 "	1.5 "	0.75 "
2d "	1.9 "	1.5 "	0.70 "
3d "	1.8 "	1.3 "	0.70 "
4th "	1.8 "	1.25 "	0.60 "
5th "	1.0 "	1.0 "	0.60 "
6th "	0.50 "	0.75 "	0.30 "
7th "	0.10 "	0.15 "	0.40 "
8th "	Traces	0.10 "	0.40 "
9th "	"	Traces	0.40 "

baths only the effect of the heat was obtained, and during the last five baths the direct rays of light fell on the naked body. He gives a table which is reproduced here, showing the effect as represented by grammes of albumin excreted per litre of urine.

His patients took a regular meal in the middle of the day, but only milk in the morning and at night. The baths lasted for from 45 minutes to an hour.

He concludes that the effect is due mainly to the light and not to the heat and calls especial attention to the small

number of treatments required.

2. Delherm examined two negroes with sleeping sickness. One was a young man who presented perfectly normal reactions to galvanism and faradism. The other was a somewhat older man in a more advanced stage of the disease and who died a short time afterward. He presented only a little hypoexcitability to faradism, this being co-extensive with the muscular atrophy which accompanied his generally feeble condition.

ELECTROTHERAPY

AN ATTEMPT TO USE THE ELECTRIC CONDUCTIVITY OF URINE FOR CLINICAL PURPOSES

G. Kolischer and L. E. Schmidt, *Illinois Medical Journal*, April, 1905.

These authors have developed a method for ascertaining whether or not a kidney is doing its normal amount of work, which involves the use of hypodermic injections of indigo-carmin for staining the urine and estimation of charges in the degree of electrical conductivity of the fluid. They find that the urine from normal kidneys always shows a slight decrease of electric conductivity after this staining has colored the secretion, which decrease, however, never exceeds nine international ohms. Urine drawn from pathological kidneys will always, after staining, show a decided increase of electric conductivity. As a result of their observations they feel justified in stating that any increase of electric conductivity, after staining, which goes beyond ten international ohms is characteristic of impaired health of the kidney. If this increase does not go beyond 20 ohms the kidney may be considered safe in a surgical sense; if the conductivity is increased beyond 20 ohms

then the kidney is to be considered absolutely unsafe and not able to do the work of the whole organism.

Such determination of the functionality of the kidney is valuable in cases where disease of one organ may indicate its removal, and information, as to the ability of the other organ to carry on the functions of the body alone, is desirable.

HYDRO-ELECTRIC TREATMENT OF FUNCTIONAL HEART DISEASES

Dr. Gustav Zimmermann, *Munchener Med. Wochenschrift*, March 21, 1905.

The hydro-electric treatment with the galvanic and faradic currents has proven useful. Experiments made by Eulenburg and his pupils have shown among other things, that the resistance of the water is indirectly proportional to its temperature; that even a slight admixture of salts decreases the resistance of water; and that the proportion of body length and the length of tube, and of the cross-sections of body and tube, has to be taken into consideration.

The sensibility of the skin and the frequency of the pulse are more or less lessened both in the galvanic and faradic

bath, and the blood pressure is increased. The excretion of urea is increased and the metabolism considerably augmented. The galvanic bath is sedative and hypnotic, while the faradic is refreshing and invigorating.

The favorable effect of the faradic bath is also noticed in the so-called alternating (sinusoidal) current bath, even in a stronger degree. The faradic current is uneven and the opening stronger than the closing current, while the alternating is a sinusoidal current with slowly and evenly increasing and decreasing E. M. F. The alternating current produces in motor nerves and muscles tetanic contractions, but only if applied with a much higher current strength than the faradic. In the alternating current bath the bather feels vibratory muscular contractions which are especially pronounced on thigh, upper arm, and chest, and appear as oscillating contractions.

In looking at the results of alternating current therapy we have to keep the subjective and objective results apart. Every objective improvement is preceded by a subjective, which often is striking and may in some cases be attributed to suggestion. Palpitation, shortness of breath, etc., considerably improve after a few baths, appetite and sleep become better, bodily and mental vigor increase in such a manner that the

patients, at times, grow enthusiastic over the treatment.

In a good many cases the blood pressure increases, the pulse rate decreases, œdema disappears, etc. But the author warns against confounding hypertrophy, compensatory dilatation (hyperdiastole, distension) and absolute dilatation. The hypertrophy of the cardiac muscle is a compensatory process and a sign of its strength and should not be treated with the alternating current bath as long as it is functionally efficient.

Valvular insufficiency is, aside from the hypertrophy, compensated by an adequate dilatation and must not be submitted to this treatment.

The alternating current bath is only indicated when the dilatation is in excess of the compensatory measure, or when an absolute dilatation has arisen as the result of a gradual distension of the cardiac walls, either in consequence of a genuine weakness, an atonic condition of the muscle, or in consequence of unusual peripheral resistance to the circulation, fatigue, emphysema, etc.

The author advises the use of the alternating current bath in circulatory disturbances with decreased blood pressure, beginning disturbances of compensation, *adipositas universalis* with moderate fat infiltration of the heart, and atonic conditions of the heart muscle and the arteries.

RADIODIAGNOSIS

ON ROENTGEN DIAGNOSIS AND THERAPY OF INTERNAL DISEASES

Prof. Dr. R. V. Jaksch, *Berliner Klin. Wochenschrift*, April 3 and 10, 1905.

The diagnosis of internal diseases by means of the Roentgen rays may be divided into two parts, radiography and radioscopy. Radiography cannot be

separated from radioscopy and radioscopy is only a supplement to radiography, and vice versa. For certain objects, especially the lungs, radiography is to be preferred to radioscopy, because on the screen details in the lungs can never be seen so well as on the photographic plate. But for the examination of the heart, esophagus, etc., radioscopy is indispensable.

The author's usual procedure, espe-

cially adapted for patients with feverish lung diseases, is as follows:

The patient is brought into the room upon his bed and a board is slipped under his back; over this the photographic plate, upon which the patient lies, and on the patient, if necessary, the compression diaphragm or orthodiascope. The distance of the anticathode from the plate is 45 to 55 centimeters (18 to 22 inches), the anticathode is placed right over the median line of the thorax. The greater distance of 55 cm. is used where more panniculus adiposus, better developed muscles, and a higher thorax are present. All pictures are taken with the patient in a horizontal position, the rays traveling in ventro-dorsal direction. The heart is always seen at the left and the other organs in normal position.

With the screen he examines dorso-ventrally, because then the organs are seen from the same point of view; the heart appears to the left, and comparison with the plate can be more easily made.

The author presented a number of negatives with his paper. In some cases of tuberculosis, it was possible, by means of the X-ray, to make a positive diagnosis before other methods could accomplish it; on the other hand a number of larger and smaller shadows in the lungs of a patient upon which he based his diagnosis of tuberculosis, proved at the autopsy to be anthracosis (particles of coal). Calcareous deposits, similar to those seen in struma, were found in one patient whose symptoms were those of tuberculosis, but who recovered.

Observations upon twelve cases of pneumonia induce him to draw the following conclusions:

First, in the majority of cases, before

the physical examination is of any service, the X-ray shows a clearing up of the shadow of the diseased lobe, the lysis often beginning in the center.

Second, the shadows of the X-ray are essentially larger than the percussion borders.

Third, the X-ray permits of the finding of centrally located pneumonia.

In cases of pleurisy gradual absorption of exudate can be observed.

The diagnosis of a mediastinal tumor was made by means of the X-ray, the post-mortem disclosing a tumor involving the right lung. In another case the clinical and X-ray diagnosis of a tumor of the upper lobe of the left lung was verified. The author is candid enough to mention another case for the wrong diagnosis of which he lays the blame upon himself, because he had overlooked a carcinoma of the right mamma.

In a case of asthma bronchiale the negative shows lighter, broader, and thinner striæ of irregular shape, which the author diagnoses as bronchi filled with fibrinated masses or similar formations.

The author presented the negative of a heart which, physically examined, appeared normal. The screen examination (dorso-ventral) showed a cor bovinum and hemisystolia; the plate (ventro-dorsal) a cor bovinum. Radioscopy is here superior to radiography. But neither radioscopy nor radiography give any information about the nature of the changes seen, e. g., whether hypertrophy or dilatation is present; valvular disease cannot be discovered.

The author comes to the conclusion that a high place must be conceded to Roentgen diagnosis, but not to Roentgentherapy.



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